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Domestic Building Services Compliance Guide

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Section 1

Introduction

Note:
Any reference to building regulations in this guide is to building regulations in England,Wales, Scotland and Northern Ireland.

1.1 Scope

This guide provides detailed guidance for persons installing ***fixed building services*** in new and existing domestic buildings to help them comply with building regulations. It covers work on both ***new systems*** and ***replacement systems***, identifying the differing requirements where these exist.

This edition of the guide covers conventional means of providing primary space heating, domestic hot water, mechanical ventilation, comfort cooling and interior lighting. In addition, it covers low carbon generation of heat by heat pumps, solar themal panels, and micro-combined heat and power systems.

The guide also refers to publications which include information on good practice for design and installation over and above the recommended minimum standards in this guide.

1.2 Innovative systems

It is important to note that this guide covers a range of frequently occurring situations and deals with the most commonly used fixed building services technologies. In doing so it neither endorses these methods and technologies nor excludes other more innovative technologies.

Innovative technologies are not excluded from the compliance process and alternative means of achieving compliance with the functional requirements of building regulations may be possible. Where the technology has been the subject of a recognised testing procedure that assesses its energy performance, this may be used to indicate that the system is adequately efficient.

In the event that there is no recognised testing standard, suitable calculations or modelling methods may be used to show the carbon performance of the system.

1.3 European Directives

Fixed building services products such as boilers, circulators and heat pumps shall at the appropriate time comply with all relevant requirements of EU Directives, including the Eco-design of Energy Using Products (EuP) Framework Directive 2005/32/EC and Directive 2009/28/EC on the Promotion of the Use of Energy from Renewable Sources (Renewable Energy Directive).

1.4 Status of guide

Building regulations contain functional requirements (called standards in Scotland), such as requirements that buildings must be structurally stable, must be constructed and fitted to ensure reasonable levels of fire protection, and must be reasonably energy efficient. These functional requirements are often drafted in broad terms, and so it may not always be immediately clear to a person carrying out work how to comply with the relevant requirements. Consequently, documents are often issued which provide practical guidance on ways of complying with specific aspects of building regulations in some of the more common building situations. Those documents are called Approved Documents in England and Wales, Technical Handbooks in Scotland and Technical Booklets in Northern Ireland.

Approved Documents, Technical Handbooks and Technical Booklets are intended to provide practical guidance but they are not intended to be comprehensive. Consequently, they may contain references to other documents which will provide more detailed information and assistance on parts of the guidance. This guide is one of those documents. It provides more detailed information on the guidance contained in Approved Documents L1A and L1B, Section 6 of the Domestic Technical Handbook, and Technical Booklet F1 about compliance with the energy efficiency requirements which apply when installing ***fixed building services*** in new and existing buildings.

Note: Following guidance in an Approved Document, Technical Handbook or Technical Booklet does not guarantee compliance with building regulations. If you follow the relevant guidance in an Approved Document, Technical Handbook or Technical Booklet and in any document referred to (such as this guide) which provides additional information to help you follow that guidance, there is a legal presumption that you have complied with building regulations. However, in every case it is for the building control body to decide whether work complies with building regulations. So, you should always check with the building control body before you start work what they consider it is necessary for you to do to comply with building regulations.

1.5 How to use this guide

The guide comprises four self-contained fuel-based sections, and nine technology-specific sections:

- Fuel-based sections:

  Section 2: Gas-fired primary and secondary space heating and hot water

  Section 3: Oil-fired primary and secondary space heating and hot water

  Section 4: Electric primary and secondary space heating and hot water

  Section 5: Solid fuel primary and secondary space heating and hot water
- Technology-specific sections:

  Section 6: Community heating

  Section 7: Underfloor heating

  Section 8: Mechanical ventilation

  Section 9: Heat pumps

  Section 10: Comfort cooling

  Section 11: Solar water heating

  Section 12: Lighting

  Section 13: Micro-combined heat and power

  Section 14: Heating system circulators

For any particular application, reference may need to be made to more than one section.

"Supplementary information" that may help with interpreting the minimum energy efficiency provisions needed to comply with the Building Regulations is in *italic font with a grey background*. In some cases there are links to best practice guidance that goes beyond the recommended minimum requirements.

Key terms are defined immediately below and at appropriate points throughout the guide. They are shown in ***italic bold font***.

1.6 Key terms

Fixed building services means any part of, or any controls associated with:

a. fixed internal or external lighting systems, but does not include emergency escape lighting or specialist process lighting; or

b. fixed systems for heating, hot water, air conditioning or mechanical ventilation.

New system means fixed building services installed in a new building or for the first time in an existing building.

Replacement system means fixed building services installed as a replacement for a system in an existing building.

Seasonal efficiency means the annual efficiency value used by SAP for a heating appliance. For gas, LPG and oil boilers that have been tested for efficiency, this is SEDBUK[1].

1.7 Replacement of primary heating appliances

When replacing an existing appliance, the efficiency of the new appliance should not be significantly less than the efficiency of the appliance being replaced. If the replacement involves a fuel switch, then the relative carbon emissions associated with the new and existing fuels should be considered when assessing the reasonableness of the proposed new appliance. The aim is to discourage replacement of an existing appliance by a significantly less carbon efficient one.

The minimum requirements are:

Replacement not involving fuel or energy switch

Where the primary heating appliance is replaced by one using the same fuel or energy supply, the seasonal efficiency of the new equipment should be:

a. as stated in the relevant fuel-based section of this guide; and

b. not worse than two percentage points lower than the seasonal efficiency of the controlled service being replaced. If the efficiency of the appliance to be replaced is not known, efficiency values may be taken from Table 4a or 4b of SAP 2009.

Replacement involving fuel or energy switch

If the new heating appliance uses a different fuel, the efficiency of the new service should be multiplied by the ratio of the CO_2 emission factor of the fuel used in the service being replaced to that of the fuel used in the new service, to obtain the "carbon equivalent efficiency". The checks described in paragraphs a. and b. above should then be made. The CO_2 emission factors should be taken from Table 12 of SAP 2009.

[1] The Boiler Efficiency Database is at www.sedbuk.com. Note: The database will give separate winter and summer (i.e. hot water) efficiencies for boilers, which SAP 2009 (at www.bre.co.uk/sap2009) uses to calculate carbon dioxide emission rates for dwellings. To avoid confusion with a prospective EuP Directive labelling scheme, the database no longer shows A to G efficiency bands for boilers.

Examples

1. An old oil-fired boiler with a seasonal efficiency of 72 per cent is to be replaced by a dual solid fuel boiler. The new dual solid fuel boiler should have:

   a. a seasonal efficiency not less than 65 per cent (from Table 18 in this guide); and

   b. a carbon equivalent efficiency not less than 70 per cent.

   A dual solid fuel boiler with a seasonal efficiency of 65 per cent will meet condition b. as its carbon equivalent efficiency is:

   65% x (0.274 ÷ 0.206) = 86.5%

   where 0.274 and 0.206 kgCO_2/kWh are the emission factors for oil and dual solid fuels respectively.

2. An LPG-fired boiler of 83 per cent efficiency is to be replaced with an oil boiler. The new oil boiler should have:

   a. a seasonal efficiency not less than 90 per cent (from Table 9); and

   b. a carbon equivalent efficiency not less than 81 per cent.

   To meet condition b., the seasonal efficiency of the proposed new oil boiler should therefore be at least:

   81% ÷ (0.245 ÷ 0.274) = 90.59%

   where 0.245 and 0.274 kgCO_2/kWh are the emission factors of LPG and oil respectively.

1.8 Energy efficiency standards for compliance with building regulations – summary table

To assist compliance with the relevant energy efficiency requirements in building regulations, this guide sets out recommended minimum energy efficiency standards for space heating, domestic hot water, cooling, ventilation and lighting, and for microgeneration of heat by heat pumps, solar thermal panels and micro-combined heat and power packages. They are summarised in the table below.

The sections that follow the table give guidance on how to meet these standards.

It is important to note that many of these recommended minimum standards will need to be exceeded if the building regulations target carbon dioxide emission rate (TER) for new dwellings is to be met.

Summary of recommended minimum energy efficiency standards for building services		
Building service	**Standard[2]**	
Gas-fired wet central heating systems	**Seasonal efficiency**	
	SEDBUK 2005[3]	**SEDBUK 2009**
Condensing boilers	90%	88%
Non-condensing boilers (where permitted)	78%	78%
Range cooker boilers	75%	75%
Gas-fired warm air heating	**Efficiency**	
	See Table 4	
Gas-fired fixed independent space heaters	**Efficiency (gross)[4]**	
Gas and LPG primary	63%	
Gas and LPG secondary heating	63% (new build) 45% (existing build)	
Decorative fuel-effect	Not specified (set to 20% in SAP 2009)	
Gas fires in combined fire/backboilers (replacement systems)	**Efficiency (gross)**	
	Natural gas	**LPG**
Inset live fuel-effect	45%	46%
All types except inset live fuel-effect	63%	64%
Oil-fired space heating and hot water systems	**Seasonal efficiency**	
	SEDBUK 2005	**SEDBUK 2009**
Condensing boilers	90%	88%
Non-condensing boilers (where permitted)	86%	86%
Range cooker boilers	80%	80%
Electric heating systems	**Efficiency**	
Boilers serving central heating systems	N/A	
Warm air systems	N/A	
Panel heaters	N/A	
Storage systems including integrated storage/ direct systems	N/A	

[2] All values are minimum values and apply to new and existing buildings, except where stated.

[3] The boiler efficiency should meet either the SEDBUK 2005 or SEDBUK 2009 standard. If the SEDBUK efficiency given in boiler literature is not dated, it should be assumed to be the SEDBUK 2005 value.

[4] Efficiency is heat output divided by calorific value of fuel. The net calorific value of a fuel excludes the latent heat of water vapour in the exhaust, and so is lower than the gross calorific value. Efficiency test results and European standards normally use net calorific values. SAP 2009, which uses gross values, gives factors in Table E4 for converting net efficiency to gross efficiency (e.g. 0.901 for natural gas, 0.921 for LPG, 0.937 for oil).

Summary of recommended minimum energy efficiency standards for building services *(continued)*			
Building service		**Standard[2]**	
Solid fuel heating systems		**Efficiency (gross)**	**Feed**
B1	Simple open fire – Inset	37%	Batch
B2	Open fire – freestanding convector	47%	Batch
B3	Open fire inset convector	45% mineral fuels 43% wood fuels	
C1/C2	Open fire and boiler (inset or freestanding)	50%	Batch
D1/D2/D3	Open fire + high output boiler (trapezium and rectangular grates)	63%	Batch
D4	Open fire + high output boiler (rectangle)	63%	Batch
E1	Dry room heater (often known as dry stove)	65%	Batch/ Automatic
E2	Dry room heater – logs only	65%	Batch
E3	Dry room heater – multi-fuel	65%	Batch
E4	Dry room heater – pellet stove	65% part load 70% nominal load	Auto
F	Room heater with boiler	67% mineral fuels and logs 70% wood pellets – part load 75% wood pellets – nominal load	Batch/ Automatic
G1	Cooker without boiler not exceeding 3.5 kW	65% mineral fuels 55% wood fuels	Batch
G2	Cooker with heating boiler exceeding 3.5 kW	65% mineral fuels 60% wood fuels	Batch
J2	Independent boiler (batch-fed) wood logs only	75%	Batch
J3	Independent boiler (batch-fed) multi-fuel	65% mineral fuels 75% wood logs	Batch
J4	Independent boiler – anthracite	70% up to 20.5 kW 75% above 20.5 kW	Automatic
J5	Independent boiler – wood/ pellets/ chips	75% nominal load 70% part load	Automatic
	Slow heat release appliances	65%	Batch
	One-off tiled/mortared stoves	70%	Batch

Summary of recommended minimum energy efficiency standards for building services *(continued)*		
Building service	**Standard[2]**	
Community heating systems	**Seasonal efficiency**	
Boilers	See *Non-domestic building services compliance guide*	
Mechanical ventilation systems	**Specific fan power (SFP) (max)**	
Intermittent extract ventilation systems	0.5 W/(l/s)	
Continuous extract ventilation systems	0.7 W/(l/s)	
Continuous supply ventilation systems	0.5 W/(l/s)	
Continuous supply and extract with heat recovery ventilation systems.	1.5 W/(l/s)	
Heat recovery	**Dry heat recovery efficiency**	
Balanced mechanical ventilation systems	70%	
Heat pump systems (BS EN 15450 Tables C1 & C2)	**Seasonal Performance Factor (SPF)**	
	New build	**Existing build**
Air/water	2.7	2.5
Ground/water	3.5	3.3
Water/water	3.8	3.5
Comfort cooling systems	**Energy efficiency ratio (EER)**	
Air-cooled air conditioners working in cooling mode	2.4	
Water-cooled air conditioners working in cooling mode	2.5	
Fixed air conditioners	> Class C in Schedule 3 of the labelling scheme *(The Energy Information (Household Air Conditioners) (No. 2) Regulations, SI 2005/1726)*	
Solar water heating	**Circulation pump power**	
	< 50W < 2% of peak thermal power of collector	

Summary of recommended minimum energy efficiency standards for building services *(continued)*	
Building service	**Standard[2]**
Fixed lighting	**Lighting efficacy**
Internal light fittings (75%)	45 lamp lumens per circuit-watt
External lighting – automatic presence and daylight control	lamp capacity < 100 lamp-watts per light fitting
External lighting – manual switching and automatic daylight control	45 lumens per circuit-watt
Micro-CHP	**Heating plant emission rate (HPER)**
	See Section 13.3 a.
Heating system circulators	**Europump Labelling Scheme rating**
Stand-alone, glandless heating system circulators	A to G

Section 2

Gas-fired space heating and hot water systems

2.1 Scope of guidance

This section provides guidance on the specification of gas-fired space heating and hot water systems[5] in dwellings to meet relevant energy efficiency requirements in building regulations. The guidance applies to systems fuelled by natural gas and liquid petroleum gas (LPG) and covers:

- wet central heating systems
- range cookers with integral central heating boilers
- warm air heating systems
- fixed independent space heating devices.

2.2 Gas-fired wet central heating systems

Gas-fired wet central heating systems for dwellings should meet the minimum standards for:

a. boiler efficiency, system circulation, hot water storage, system preparation and commissioning in Table 1

b. boiler interlock, zoning, and time and temperature control of the heating and hot water circuits in Table 2

c. pipework insulation in Table 3.

[5] All gas appliances must be installed by a competent person in accordance with the current issue of the Gas Safety (Installation and Use) Regulations. The installation should follow the manufacturer's instructions and should comply with all relevant parts of the Building Regulations and, for wet systems, the Water Regulations.

Table 1: Recommended minimum standards for efficiency, system circulation, hot water storage, system preparation and commissioning for gas-fired wet central heating systems			
Gas-fired wet heating	**New systems**	**Replacement systems**	**Supplementary information**
1.0 Efficiency	a. The boiler SEDBUK 2005 efficiency shou ld be not less than 90% (or 88% as rated by SEDBUK 2009). b. In existing dwellings, in the exceptional circumstances defined in the CLG *Guide to the condensing boiler installation assessment procedure for dwellings*[6], the boiler SEDBUK 2005 (or SEDBUK 2009) efficiency should be not less than 78% if natural gas-fired, or not less than 80% if LPG-fired. c. The boiler efficiency for heating boilers that are combined with range cookers should be as defined in Section 2.3 *Gas-fired range cookers with integral central heating boiler*.	**Replacements not involving a fuel or energy switch** a. The boiler seasonal efficiency should be as defined for new systems; and b. not worse than two percentage points lower than the seasonal efficiency of the controlled service being replaced. If the efficiency of the system or appliance to be replaced is not known, efficiency values may be taken from Table 4a or 4b of SAP 2009. **Replacements involving fuel or energy switch** a. If the new heating system or heat generating appliance uses a different fuel, the efficiency of the new service should be multiplied by the ratio of the CO_2 emission factor of the fuel used in the service being replaced to that used in the new service before making the checks in a. and b. above. The CO_2 emission factors should be taken from Table 12 of SAP 2009.	*The SEDBUK method for determining efficiency has been revised in SAP 2009. SEDBUK 2009 values are different from SEDBUK 2005. The Boiler Efficiency Database at www.sedbuk.com gives both, together with separate winter and summer (i.e. hot water) efficiencies for boilers that are used by SAP 2009 to calculate the carbon dioxide emission rate for dwellings. If the SEDBUK efficiency given in a boiler manufacturer's literature does not give a date, it should be assumed to be the SEDBUK 2005 value.* *The CLG "Guide to the condensing boiler installation assessment procedure for dwellings" sets out the approved procedure for establishing the exceptional circumstances in which boilers may be of the non-condensing type.*

[6] *Guide to the condensing boiler installation assessment procedure for dwellings*, CLG, 2005. Available from www.planningportal.gov.uk/approveddocuments

Table 1: Recommended minimum standards for efficiency, system circulation, hot water storage, system preparation and commissioning for gas-fired wet central heating systems *(continued)*			
Gas-fired wet heating	**New systems**	**Replacement systems**	**Supplementary information**
1.0 Efficiency *(continued)*			*Where condensing boilers are fitted, systems should be designed so as to provide low primary system return temperatures, preferably less than 55 degC, which maximise condensing operation. Low temperature heat emitters such as underfloor heating and weather compensation are examples of techniques which provide low return water temperatures.*
2.0 System circulation	a. Space heating systems and domestic hot water primary circuits should have fully pumped circulation. b. If the boiler manufacturer's instructions advise installation of a bypass, an automatic bypass valve should be provided and the manufacturer's instructions on minimum pipe length followed.	a. As for ***new systems***. b. When boilers are replaced, existing systems with semi-gravity circulation should be converted to fully pumped circulation.	

Table 1: Recommended minimum standards for efficiency, system circulation, hot water storage, system preparation and commissioning for gas-fired wet central heating systems *(continued)*			
Gas-fired wet heating	**New systems**	**Replacement systems**	**Supplementary information**
3.0 Hot water storage	a. Vented copper hot water storage cylinders should comply with the heat loss and heat exchanger requirements of BS 1566:2002 Part 1. b. Copper hot water storage combination units should comply with BS 3198:1981. c. Primary storage systems should meet the insulation requirements of the Hot Water Association *Performance specification for thermal stores*. d. Unvented hot water storage system products should comply with BS EN 12897: 2006 or an equivalent standard as set by an accredited test body such as the British Board of Agrément, the Water Research Council, or KIWA.	a. As for ***new systems***, but b. for replacement copper vented cylinders and combination units, the standing loss should not exceed $Q = 1.28 \times (0.2+0.051V^{2/3})$ kWh/day, where V is the volume of the cylinder.	*If a vented cylinder is made from an alternative material to copper then the heat loss and heat exchange characteristics should be tested in accordance with BS EN 12897:2006. The HWA thermal storage specification is available for free download from www.hotwater.org.uk.* ***British Standards*** *BS 1566: 2002 "Copper indirect cylinders for domestic purposes. Open vented copper cylinders. Requirements and test methods".* *BS EN 12897 "Water supply. Specification for indirectly heated unvented (closed) storage water heaters".* *BS 3198 "Copper hot water storage combination units for domestic purposes".*

Table 1: Recommended minimum standards for efficiency, system circulation, hot water storage, system preparation and commissioning for gas-fired wet central heating systems *(continued)*			
Gas-fired wet heating	**New systems**	**Replacement systems**	**Supplementary information**
3.0 Hot water storage *(continued)*	e. The standing heat loss for all hot water storage vessels in a, b, c and d above should not exceed $Q = 1.15 \times (0.2+0.051V^{2/3})$ kWh/day, where V is the volume of the cylinder. f. All hot water vessels should carry a label with the following information: i. type of vessel (vented, unvented, combination unit or thermal store); ii. nominal capacity in litres; iii standing heat loss in kWh/day; iv. heat exchanger performance in kW; v. reference to product compliance with relevant standard (e.g. BS 1566, BS 12897) and logos of accreditation bodies as required. For labelling requirements for other heat inputs, see relevant sections (e.g. Section 11 for solar).		

Table 1: Recommended minimum standards for efficiency, system circulation, hot water storage, system preparation and commissioning for gas-fired wet central heating systems *(continued)*			
Gas-fired wet heating	**New systems**	**Replacement systems**	**Supplementary information**
4.0 System preparation and water treatment	a. Central heating systems should be thoroughly cleaned and flushed out before installing a new boiler. b. During final filling of the system, a chemical water treatment inhibitor meeting the manufacturer's specification or other appropriate standard should be added to the primary circuit to control corrosion and the formation of scale and sludge. c. Installers should also refer to the boiler manufacturer's installation instructions for appropriate treatment products and special requirements for individual boiler models. d. Where the mains total water hardness exceeds 200 parts per million, and if required by the manufacturer, provision should be made to treat the feed water to water heaters and the hot water circuit of combination boilers to reduce the rate of accumulation of limescale. e. For solar thermal systems, see Section 11.	a. As for ***new systems***.	*Inhibitors should as a minimum be BuildCert approved.* *Limescale can be controlled by the use of chemical limescale inhibitors, combined corrosion and limescale inhibitors, polyphosphate dosing, electrolytic scale reducers or water softeners.* *The relevant standard for water treatment is BS 7593:2006 "Code of practice for treatment of water in domestic hot water central heating systems".* *BS 7593 notes that soft water has an increased potential for corrosion, and this may influence the choice of corrosion inhibitor. Where water is artificially softened, it is advisable to feed unsoftened water not only to drinking water taps, but also to the boiler primary circuit. In soft water areas, the boiler manufacturer should be consulted for advice.* *In order to avoid loss and consequent replacement of circulating fluid and water treatment when removing radiators for service or maintenance, it is advisable to install radiator valves that can isolate not only the heating circuit but also seal off the radiators.*

Table 1: Recommended minimum standards for efficiency, system circulation, hot water storage, system preparation and commissioning for gas-fired wet central heating systems *(continued)*

Gas-fired wet heating	New systems	Replacement systems	Supplementary information
5.0 Commiss-ioning	a. On completion of the installation of a boiler or hot water storage system, together with associated equipment such as pipework, pumps and controls, the equipment should be commissioned in accordance with the manufacturer's instructions. These instructions will be specific to the particular boiler or hot water storage system. b. The installer should give a full explanation of the system and its operation to the user, including the manufacturer's User Manual where provided.	a. As for ***new systems***.	***The Benchmark System*** *The Benchmark Commissioning Checklist can be used to show that commissioning has been carried out satisfactorily. Benchmark licence-holders provide a checklist with the appliance for completion by the persons commissioning the system so that they can record that all the checks have been made and the results show efficient operation of the equipment in compliance with building regulations. The Benchmark checklist should be provided to the builder, or the householder in the case of work in existing dwellings, an appointed agent, or the end user.* *A Benchmark Commissioning Checklist will be included in all HHIC gas boiler manufacturer members' installation manuals to help installers record information about the installation in order to assist with servicing and repairs. For example, details of system cleaners and inhibitors can be recorded.*

Table 1: Recommended minimum standards for efficiency, system circulation, hot water storage, system preparation and commissioning for gas-fired wet central heating systems *(continued)*			
Gas-fired wet heating	**New systems**	**Replacement systems**	**Supplementary information**
5.0 Commiss-ioning *(continued)*			*Only manufacturing companies who hold a Benchmark licence will be eligible to use the Benchmark logo and the approved log book wording and layout. (Benchmark is registered as a European Collective Mark by the Heating and Hot Water Industry Council and the content is copyright.)*

Table 2: Recommended minimum standards for control of gas-fired wet central heating systems		
Gas-fired wet heating	**New systems**	**Replacement systems**
1.0 Boiler interlock	a. Boiler-based systems should have a boiler control interlock in which controls are wired so that when there is no demand for either space heating or hot water, the boiler and pump are switched off. b. The use of thermostatic radiator valves (TRVs) alone does not provide interlock.	a. As for ***new systems***.
2.0 Space heating zones	a. Dwellings with a total usable floor area up to 150 m^2 should be divided into at least two space heating zones with independent temperature control, one of which is assigned to the living area. b. Dwellings with a total usable floor area greater than 150 m^2 should be provided with at least two space heating zones, each having separate timing and temperature controls. c. For single-storey open-plan dwellings in which the living area is greater than 70% of the total floor area, sub-zoning of temperature control is not appropriate.	a. As for ***new systems***.
3.0 Water heating zones	a. All dwellings should have a separate hot water zone in addition to space heating zones. b. A separate hot water zone is not required if the hot water is produced instantaneously, such as with a combination boiler.	a. As for ***new systems***.

Table 2: Recommended minimum standards for control of gas-fired wet central heating systems *(continued)*		
Gas-fired wet heating	**New systems**	**Replacement systems**
4.0 Time control of space and water heating	a. Time control of space and water heating should be provided by: i. a full programmer with separate timing to each circuit; or ii. two or more separate timers providing timing control to each circuit; or iii. programmable room thermostat(s) to the heating circuit(s), with separate timing of the hot water circuit. b. For dwellings with a total usable floor area greater than 150 m^2, timing of the separate space heating zones can be achieved by: i. multiple heating zone programmers; or ii. a single multi-channel programmer; or iii. programmable room thermostats; or iv. separate timers to each circuit; or v. a combination of (iii) and (iv) above. c. Where the hot water is produced instantaneously, such as with a combination boiler, time control is only required for space heating zones.	a. As for ***new systems*** unless only the hot water cylinder is being replaced and separate time control for the hot water circuit is not present. In this case it is acceptable to have a single timing control for both space heating and hot water.
5.0 Temperature control of space heating	a. Separate temperature control of zones within the dwelling should be provided using: i. room thermostats or programmable room thermostats in all zones; and ii. individual radiator controls such as thermostatic radiator valves (TRVs) on all radiators other than in reference rooms (with a thermostat) and bathrooms.	a. As for ***new systems***.*

Table 2: Recommended minimum standards for control of gas-fired wet central heating systems *(continued)*

Gas-fired wet heating	New systems	Replacement systems
6.0 Temperature control of domestic hot water	a. Domestic hot water systems should be provided with a cylinder thermostat and a zone valve or three-port valve to control the temperature of stored hot water. b. In dwellings with a total floor area greater than 150 m^2 it would be reasonable to provide more than one hot water circuit, each with separate timing and temperature controls. This can be achieved by: i. multiple heating zone programmers; or ii. a single multi-channel programmer; or iii separate timers to each circuit. c. Non-electric hot water controllers should not be used. Also, in some circumstances, such as with thermal stores, a zone valve is not appropriate; a second pump could be substituted for the zone valve.	a. As for ***new systems*** for planned replacement of hot water cylinders on all fully pumped installations, and on gravity circulation installations. b. In exceptional circumstances, such as emergency replacement or where the cylinder or installation is of a type that precludes the fitting of wired controls, either a wireless or thermomechanical hot water cylinder thermostat would be acceptable.

Supplementary information

More details on control systems can be found in manufacturers' literature and on the The Association of Controls Manufacturers (TACMA) website at www.heatingcontrols.org.uk.

Controls may be provided by any boiler management control system that meets the specified zoning, timing and temperature and boiler interlock control requirements.

**When an individual system component – such as the boiler or a room thermostat – is being replaced, it is not necessary to upgrade the whole system. However, while not essential for compliance with building regulations, in the case of a boiler replacement, because the system has to be drained down, it would be good practice to install thermostatic radiator valves (or equivalent) on all radiators other than in the room with the main thermostat, provided the radiators are suitable and pipework does not need to be altered.*

Table 3: Recommended minimum standards for insulation of pipework in gas-fired wet central heating systems

<table>
<tr><th>New systems</th><th>Supplementary information</th></tr>
<tr><td rowspan="11">a. Pipes should be insulated to comply with the maximum permissible heat loss indicated in the Supplementary Information column, and labelled accordingly, as follows:
i. Primary circulation pipes for heating and hot water circuits should be insulated wherever they pass outside the heated living space or through voids which communicate with and are ventilated from unheated spaces.
ii. Primary circulation pipes for domestic hot water circuits should be insulated throughout their length, subject only to practical constraints imposed by the need to penetrate joists and other structural elements.
iii. All pipes connected to hot water storage vessels, including the vent pipe, should be insulated for at least 1 metre from their points of connection to the cylinder (or they should be insulated up to the point where they become concealed).
iv. If secondary circulation is used, all pipes kept hot by that circulation should be insulated.</td><td>Insulation of pipework in unheated areas
Extra provision may need to be made to protect central heating and hot water pipework in unheated areas against freezing. Guidance is available in:
• BS 5422:2009 “Method for specifying thermal insulating materials for pipes, tanks, vessels, ductwork and equipment operating within the temperature range -40°C to +700°C”.
• BRE Report No 262 “Thermal insulation: avoiding risks”, 2002 Edition.</td></tr>
<tr><td>Where insulation is labelled as complying with this guide, it must not exceed the following heat loss levels:</td></tr>
<tr><td>
<table>
<tr><th>Pipe outside diameter</th><th>Maximum heat loss*</th></tr>
<tr><td>8 mm</td><td>7.06 W/m</td></tr>
<tr><td>10 mm</td><td>7.23 W/m</td></tr>
<tr><td>12 mm</td><td>7.35 W/m</td></tr>
<tr><td>15 mm</td><td>7.89 W/m</td></tr>
<tr><td>22 mm</td><td>9.12 W/m</td></tr>
<tr><td>28 mm</td><td>10.07 W/m</td></tr>
<tr><td>35 mm</td><td>11.08 W/m</td></tr>
<tr><td>42 mm</td><td>12.19 W/m</td></tr>
<tr><td>54 mm</td><td>14.12 W/m</td></tr>
</table>
</td></tr>
<tr><td>*In assessing the thickness of insulation required, standardised conditions should be assumed in all compliance calculations, based on a horizontal pipe at 60°C in still air at 15°C. Further guidance on converting heat loss limits to insulation thickness for specific thermal conductivities is available in TIMSA “HVAC guidance for achieving compliance with Part L of the Building Regulations”.</td></tr>
<tr><td>Replacement systems</td><td></td></tr>
<tr><td>a. Whenever a boiler or hot water storage vessel is replaced in an existing system, any pipes that are exposed as part of the work or are otherwise accessible should be insulated as recommended above – or to some lesser standard where practical constraints dictate.</td><td></td></tr>
</table>

2.3 Gas-fired range cookers with integral central heating boiler

Note:
This section does not apply to appliances with fully independent boiler and cooker parts within a shared case. For these, the standards for the boiler are as set out in Section 2.2.

Gas-fired range cookers with integral central heating boiler (within a single appliance body), provided as ***new systems*** or ***replacement systems,*** should meet the following standards:

a. The appliance should have two independently controlled burners (one for the cooking function and one for the boiler).

b. The integral boiler should have a seasonal efficiency (SEDBUK 2005 or SEDBUK 2009) in excess of 75%. The manufacturer's declaration of appliance performance and SEDBUK value should include the following words:

   i. Seasonal efficiency (SEDBUK) = xx %

   ii. Case heat emission value = yy kW

   iii. Heat transfer to water at full load = zz kW

   iv. The values are used in the UK Government's Standard Assessment Procedure (SAP) for the energy rating of dwellings. The test data from which the values have been calculated has been certified by {insert name and/or identification of Notified body}. See: www.rangeefficiency.org.uk.

   If the integral boiler is a condensing boiler, the declaration should make clear whether the efficiency has been calculated in accordance with SEDBUK 2005 or SEDBUK 2009. If it does not, then SEDBUK 2005 must be assumed.

c. The integral boiler should meet the minimum standards for system circulation, hot water storage, system preparation, commissioning, controls and insulation in Tables 1, 2 and 3 (gas-fired central heating systems).

2.4 Gas-fired warm air heating

Gas-fired warm air heating systems provided as ***new systems*** and ***replacement systems*** should meet the minimum standards for:

a. efficiency and installation in Table 4; and

b. zoning, time control and temperature control for space heating in Table 5a, and for space heating combined with water heating in Table 5b.

Table 4: Recommended minimum standards for efficiency and installation for gas-fired warm air heating systems		
Gas-fired warm air heating	**New and replacement systems**	**Supplementary information**
1.0 Efficiency	a. Gas-fired warm air units should meet the requirements, as appropriate to the design of the appliance, of: i. BS EN 778: 2009; or ii. BS EN 1319: 2009. b. If a gas-fired circulator is incorporated in the warm air unit to provide domestic hot water, it should be able to deliver full and part load efficiency at least equal to that prescribed by BS EN 483:2000. c. The manufacturer's declaration of appliance performance should include the following words: i. **Combined warm air unit and circulator** *This product has been assessed against the test methods set out in BS EN 778:2009*/BS EN 1319:2009*/BS EN 483* and certified as meeting those minimum requirements by {insert name or identification of Notified Body}.* ii. **Warm air unit alone** *This product has been assessed against the test method set out in BS EN 778: 2009* or BS EN 1319: 2009* and certified as meeting the minimum requirements by {insert name and/or identification of Notified Body}.* *Delete as appropriate	***British standards*** *BS EN 778:2009 "Domestic gas-fired forced convection air heaters for space heating not exceeding a net heat input of 70 kW, without a fan to assist transportation of combustion air and/or combustion products".* *BS EN 1319:2009 "Domestic gas-fired forced convection air heaters for space heating, with fan-assisted burners not exceeding a net heat input of 70 kW".* *BS EN 483:2000 "Gas-fired central heating boilers. Type C boilers of nominal heat input not exceeding 70 kW".*

Table 4: Recommended minimum standards for efficiency and installation for gas-fired warm air heating systems *(continued)*		
Gas-fired warm air heating	**New and replacement systems**	**Supplementary information**
2.0 Installation	a. The system should be installed in accordance with BS 5864:2004. b. Ductwork that is newly installed or replaced should be insulated in accordance with the recommendations of BS 5422:2009.	*BS 5864:2004 "Installation and maintenance of gas-fired ducted air heaters of rated input not exceeding 70 kW net (second and third family gases). Specification".* *BS 5422:2009 "Method for specifying thermal insulating materials for pipes, tanks, vessels, ductwork and equipment operating within the temperature range of -40°C to +700°C".*

Table 5a: Recommended minimum standards for control of gas-fired warm air heating without water heating	
Gas-fired warm air heating without hot water	**New and replacement systems**
1.0 Time and temperature control	a. Controls external to heater: time switch/programmer and room thermostat, or programmable room thermostat; or b. controls integrated in the heater: time-switch/programmer and room temperature sensor linked to heater firing and fan speed control.
2.0 Zoning	a. New dwellings with a total usable floor area up to 150 m^2 should be divided into at least two space heating zones with independent temperature controls, one of which is assigned to the living area. b. New dwellings with a total usable floor area greater than 150 m^2 should be provided with at least two space heating zones, each having separate timing and temperature controls. Timing of the separate space heating zones can be achieved by: i. multiple heating zone programmers; or ii. a single multi-channel programmer; or iii. programmable room thermostats; or iv. separate timers to each circuit; or v. a combination of iii) and (iv) above. c. The provisions for zoning for ***replacement systems*** in existing dwellings should be as for new dwellings where practical.

Table 5b: Recommended minimum standards for control of gas-fired warm air heating with water heating	
Gas-fired warm air heating with hot water	**New and replacement systems**
1.0 System circulation	a. Pumped primary circulation to the hot water cylinder.
2.0 Time and temperature control	a. Independent time control of both the space heating and hot water circuits. b. Time control should be provided by use of either: i. a full programmer with separate timing to each circuit; or ii. two or more separate timers providing timing control to each circuit; or iii. programmable room thermostat(s) to the heating circuit(s), with separate timing of the hot water; or iv. a time switch/programmer (two channel) and room thermostat. c. For ***new systems***: Independent control of the hot water circuit should be achieved by means of a cylinder thermostat and a timing device, wired such that when there is no demand for hot water both the pump and circulator are switched off. d. For ***replacement systems***: Independent control of the hot water circuit should be achieved, where practicable, for circulator water heaters of less than 6 kW output by means of a cylinder thermostat and a timing device, wired such that when there is no demand for hot water both the pump and circulator are switched off.
3.0 Space heating zoning	a. New dwellings with a total usable floor area up to 150 m^2 should be divided into at least two space heating zones with independent timing controls, one of which is assigned to the living area. b. New dwellings with a total usable floor area greater than 150 m^2 should be provided with at least two space heating zones, each having separate timing and temperature controls. c. The provisions for zoning for ***replacement systems*** in existing dwellings should be as for new dwellings where practical.

2.5 Gas-fired fixed independent space heating appliances

Fixed independent space heating appliances may be installed as a means of primary or secondary space heating.

Gas-fired fixed independent appliances for primary space heating

Gas-fired fixed independent space heating appliances in new and existing dwellings which are provided as the primary heat source should meet the following conditions:

a. the appliance should be one of the types described in Table 6

b. the efficiency of the appliance (gross calorific value) should be not less than 63 per cent (70% net)

c. the appliance manufacturer's declaration of appliance performance should include the following words:

The efficiency of this appliance has been measured as specified in {insert appropriate entry from Table 6} and the result after conversion to gross using the appropriate factor from Table E4 of SAP 2009 is [x] %. The test data has been certified by {insert name and/or identification of Notified Body}. The efficiency value may be used in the UK Government's Standard Assessment Procedure (SAP) for energy rating of dwellings.

d. in new dwellings, each appliance should be capable, either independently or in conjunction with room thermostats or other suitable temperature sensing devices, of controlling the temperatures independently in areas that have different heating needs (e.g. separate sleeping and living areas). In existing dwellings, wherever practical, temperature controls should be upgraded to the standards required for new dwellings.

Table 6: Acceptable types of natural gas and LPG-fired fixed independent appliances for primary space heating

British Standard designation (appliance type)
BS EN 1266:2002 *Independent gas-fired convection heaters incorporating a fan to assist transportation of combustion air and/or flue gases.* BS 7977-1:2002 *Specification for safety and rational use of energy of domestic gas appliances. Radiant/convectors.* BS EN 613:2001 *Independent gas-fired convection heaters.* BS EN 13278:2003 *Open fronted gas-fired independent space heaters.*

Gas-fired fixed independent appliances for secondary space heating

Gas-fired fixed independent space heating appliances which are provided as the secondary heat source should meet the following conditions:

a. in new dwellings, the appliance efficiency (gross calorific value) should be not less than 63 per cent (70% net)

b. in existing dwellings, the appliance efficiency (gross calorific value) should be not less than 45 per cent (50% net)

c. the appliance manufacturer's declaration of appliance performance should include the following words:

The efficiency of this appliance has been measured as specified in {insert appropriate entry from Table 7} and the result after conversion to gross using the appropriate factor from Table E4 of SAP 2009 is [x]%. The test data has been certified by {insert name and/or identification of Notified Body}. The efficiency value may be used in the UK Government's Standard Assessment Procedure (SAP) for energy rating of dwellings.

Table 7: Acceptable types of natural gas and LPG-fired fixed independent appliances for secondary space heating	
BS EN 1266: 2002 *Independent gas-fired convection heaters incorporating a fan to assist transportation of combustion air and/or flue gases*	
BS 7977-1: 2002 *Specification for safety and rational use of energy of domestic gas appliances. Radiant/convectors*	
BS EN 613: 2001 *Independent gas-fired convection heaters*	
BS EN 13278: 2003 *Open fronted gas-fired independent space heaters*	
Flueless BS EN 14829: 2007 *Independent gas-fired flueless space heaters for nominal heat input not exceeding 6 kW*	Thermal efficiency requirements for this type of appliance are not specified as all the heat produced by the combustion process is released into the space to be heated. In SAP 2009 the efficiency of these appliances is classed as 90% and an adjustment is made for ventilation in the space heating requirement calculation.
BS EN 449: 2002 *Specification for dedicated liquefied petroleum gas appliances. Domestic flueless space heaters (including diffusive catalytic combustion heaters)*	

2.6 Gas-fired fixed decorative fuel-effect fires

This type of appliance is intended for decorative purposes and therefore a minimum thermal efficiency is not specified. Note that for the purposes of SAP 2009 the efficiency of decorative fuel-effect fires is classed as 20 per cent for use in the space heating requirement calculation. See Table 4a of SAP 2009.

Gas-fired decorative fires in new and existing dwellings should:

a. meet the product standards in BS EN 509: 2000 *Decorative fuel-effect gas appliances*; and

b. number not more than one appliance per 100 m^2 of dwelling floor area.

2.7 Gas fires for secondary space heating provided as part of a combined fire and back boiler unit

Gas fires provided as a secondary heat source as part of a combined fire and back boiler unit, when provided as a ***replacement system*** in existing dwellings, should meet the following conditions:

a. the appliance should be one of the types described in Table 8

b. the efficiency (gross calorific value) of the appliance should be not less than the value in Table 8 for that type of appliance

c. the appliance manufacturer's declaration of appliance performance should include the following words:

The efficiency of this appliance has been measured as specified in {insert appropriate entry from Table 8} and the result after conversion to gross using the appropriate factor from Table E4 of SAP 2009 is [x]%. The test data from which it has been calculated has been certified by {insert name and/or identification of Notified Body}. The efficiency value may be used in the UK Government's Standard Assessment Procedure (SAP) for energy rating of dwellings.

Table 8: Minimum appliance efficiencies for gas fires in a combined fire and back boiler unit

	Minimum efficiency % (Gross calorific value)	
British Standard designation (appliance type)	**Natural gas**	**LPG**
Inset live fuel-effect BS 7977-2:2003 *Specification for safety and rational use of energy of domestic gas appliances. Combined appliances. Gas fire/back boiler.*	45	46
All types except inset live fuel-effect BS 7977-2:2003 *Specification for safety and rational use of energy of domestic gas appliances. Combined appliances. Gas fire/back boiler.*	63	64

Table 8: Minimum appliance efficiencies for gas fires in a combined fire and back boiler unit *(continued)*

Supplementary information – further guidance on gas-fired heating

Energy Efficiency Best Practice in Housing publications:

- *CE30 "Domestic heating by gas: boiler systems"*
- *CE51 "Central heating system specifications (CHeSS)"*
- *CE54 "Whole house boiler sizing method for houses and flats".*

SBGI publications on gas boilers and gas fires under development at the time of writing:

- *See www.sbgi.org.uk for updates.*

CORGI Domestic Manual Series:

- *GID1 "Essential gas safety"*
- *GID2 "Gas cookers and ranges"*
- *GID3 "Gas fires and space heaters"*
- *GID5 "Water heaters"*
- *GID7 "Central heating wet and dry"*

CORGI Design Guides:

- *WCH1 "Wet central heating system design guide"*
- *WAH1 "Warm air heating system design guide".*

British Standards

BS 5440-1:2008 "Flueing and ventilation for gas appliances of rated input not exceeding 70 kW net (1st, 2nd and 3rd family gases). Specification for installation of gas appliances to chimneys and for maintenance of chimneys".
BS 5440-1:2009 "Flueing and ventilation for gas appliances of rated input not exceeding 70 kW net (1st, 2nd and 3rd family gases). Specification for the installation and maintenance of ventilation provision for gas appliances".
BS EN 12828:2003 "Heating systems in buildings. Design for water-based heating systems".
BS EN 12831:2003 "Heating systems in buildings. Method for calculation of the design heat load".
BS EN 14336:2004 "Heating systems in buildings. Installation and commissioning of water-based heating systems".
BS 6798:2009 "Specification for installation and maintenance of gas-fired boilers of rated input not exceeding 70 kW net".
BS 5871-1:2005 "Specification for the installation and maintenance of gas fires, convector heaters, fire/back boilers and decorative fuel effect gas appliances. Gas fires, convector heaters, fire/back boilers and heating stoves (2nd and 3rd family gases)".
BS 5871-2:2005 "Specification for the installation and maintenance of gas fires, convector heaters, fire/back boilers and decorative fuel effect gas appliances. Inset live fuel effect gas fires of heat input not exceeding 15 kW, and fire/back boilers (2nd and 3rd family gases)".
BS 5871-3:2005 "Specification for the installation and maintenance of gas fires, convector heaters, fire/back boilers and decorative fuel effect gas appliances. Decorative fuel effect gas appliances of heat input not exceeding 20 kW (2nd and 3rd family gases)".
BS 5871-4:2007 "Specification for the installation and maintenance of gas fires, convector heaters, fire/back boilers and decorative fuel effect gas appliances. Independent gas-fired flueless fires, convector heaters and heating stoves of nominal heat input not exceeding 6 kW (2nd and 3rd family gases)".

Section 3

Oil-fired space heating and hot water systems

3.1 Scope of guidance

This section provides guidance on the specification of oil-fired space heating and hot water systems[7] in dwellings to meet relevant energy efficiency requirements in building regulations. The guidance applies to the following types of oil-fired heating system:

- wet central heating systems
- range cookers with integral central heating boilers
- vaporising appliances providing secondary heating or hot water
- fixed independent space heating devices.

3.2 Oil-fired wet central heating systems

Oil-fired central heating systems which are provided as ***new systems*** or ***replacement systems*** in dwellings should meet the minimum standards for:

a. boiler efficiency, system circulation, hot water storage, system preparation and commissioning in Table 9

b. boiler interlock, zoning, and time and temperature control of the heating and hot water circuits in Table 10

c. pipework insulation in Table 11.

[7] All gas appliances must be installed by a competent person in accordance with the current issue of the Gas Safety (Installation and Use) Regulations. The installation should follow the manufacturerís instructions and should comply with all relevant parts of the Building Regulations and, for wet systems, the Water Regulations.

Table 9: Recommended minimum standards for efficiency, system circulation, hot water storage, system preparation and commissioning for oil-fired wet central heating systems

Oil-fired wet heating	New systems	Replacement systems	Supplementary information
1.0 Efficiency	**Boilers** a. The boiler should be of the condensing type. b. The boiler SEDBUK 2005 efficiency should be not less than 90% (or 88% as rated by SEDBUK 2009). c. In existing dwellings, compliance with the requirements for boiler efficiency can be demonstrated by following the guidance in the CLG *Guide to the condensing boiler installation assessment procedure for dwellings*. **Combination boilers** a. The boiler SEDBUK 2005 (or SEDBUK 2009) efficiency should be not less than 86%. b. In existing dwellings, compliance with the requirements for boiler efficiency can be demonstrated by following the guidance in the CLG *Guide to the condensing boiler installation assessment procedure for dwellings*.	**Replacements not involving a fuel or energy switch** a. The boiler seasonal efficiency should be as defined for new systems; and b. not worse than two percentage points lower than the seasonal efficiency of the controlled service being replaced. If the efficiency of the system or appliance to be replaced is not known, efficiency values may be taken from Table 4a or 4b of SAP 2009. **Replacements involving fuel or energy switch** a. If the new heating system or heat generating appliance uses a different fuel, the efficiency of the new service should be multiplied by the ratio of the CO_2 emission factor of the fuel used in the service being replaced to that used in the new service before making the checks in a and b above. The CO_2 emission factors should be taken from Table 12 of SAP 2009.	*The SEDBUK method for determining efficiency has been revised in SAP 2009. SEDBUK 2009 values are different from SEDBUK 2005. The Boiler Efficiency Database at www.sedbuk.com gives both, together with separate winter and summer (i.e. hot water) efficiencies for boilers that are used by SAP 2009 to calculate the carbon dioxide emission rate for dwellings. If the SEDBUK efficiency given in a boiler manufacturer's literature does not give a date, it should be assumed to be the SEDBUK 2005 value.* *The CLG "Guide to the condensing boiler installation assessment procedure for dwellings" sets out the approved procedure for establishing the exceptional circumstances in which boilers may be of the non-condensing type.*

Table 9: Recommended minimum standards for efficiency, system circulation, hot water storage, system preparation and commissioning for oil-fired wet central heating systems *(continued)*			
Oil-fired wet heating	**New systems**	**Replacement systems**	**Supplementary information**
1.0 Efficiency *(continued)*	**Range cooker boilers** a. The boiler efficiency for heating boilers that are combined with range cookers should be as defined in Section 3.3 *Oil-fired cookers with integral central heating boilers*.		*Where condensing boilers are fitted systems should be designed so as to provide low primary system return temperatures, preferably less than 55 degC, which maximise condensing operation. Low temperature heat emitters such as underfloor heating and weather compensation are examples of techniques which provide low return water temperatures.*
2.0 System circulation	a. Space heating systems and domestic hot water primary circuits should have fully pumped circulation. b. If the boiler manufacturer's instructions advise installation of a bypass, an automatic bypass valve should be provided and the manufacturer's instructions on minimum pipe length followed.	a. As for ***new systems***. b. When boilers are replaced, existing systems with semi-gravity circulation should be converted to fully pumped circulation.	

Table 9: Recommended minimum standards for efficiency, system circulation, hot water storage, system preparation and commissioning for oil-fired wet central heating systems *(continued)*

Oil-fired wet heating	New systems	Replacement systems	Supplementary information
3.0 Hot water storage	a. Vented copper hot water storage cylinders should comply with the heat loss and heat exchanger requirements of BS 1566:2002 Part 1. b. Copper hot water storage combination units should comply with BS 3198:1981. c. Primary storage systems should meet the insulation requirements of the Hot Water Association *Performance specification for thermal stores*. d. Unvented hot water storage system products should comply with BS EN 12897: 2006 or an equivalent standard as set by an accredited test body such as the British Board of Agrément, the Water Research Council, or KIWA. e. The standing heat loss for all hot water storage vessels in a, b, c and d above should not exceed $Q = 1.15 \times (0.2+0.051V^{2/3})$ kWh/day, where V is the volume of the cylinder.	a. As for ***new systems***, but b. for replacement copper vented cylinders and combination units, the standing loss should not exceed $Q = 1.28 \times (0.2+0.051V^{2/3})$ kWh/day, where V is the volume of the cylinder.	*If a vented cylinder is made from an alternative material to copper then the heat loss and heat exchange characteristics should be tested in accordance with BS EN 12897:2006.* *The HWA thermal storage specification is available for free download from www.hotwater.org.uk.* ***British Standards*** *BS 1566: 2002 "Copper indirect cylinders for domestic purposes. Open vented copper cylinders. Requirements and test methods".* *BS EN 12897 "Water supply. Specification for indirectly heated unvented (closed) storage water heaters".* *BS 3198 "Copper hot water storage combination units for domestic purposes".*

Table 9: Recommended minimum standards for efficiency, system circulation, hot water storage, system preparation and commissioning for oil-fired wet central heating systems *(continued)*			
Oil-fired wet heating	**New systems**	**Replacement systems**	**Supplementary information**
3.0 Hot water storage *(continued)*	f. All hot water vessels should carry a label with the following information: i. type of vessel (vented, unvented, combination unit or thermal store); ii. nominal capacity in litres; iii. standing heat loss in kWh/day; iv. heat exchanger performance in kW; v. reference to product compliance with relevant standard (e.g. BS 1566, BS 12897) and logos of accreditation bodies as required. For labelling requirements for other heat inputs, see relevant sections (e.g. Section 11 for solar).		

Table 9: Recommended minimum standards for efficiency, system circulation, hot water storage, system preparation and commissioning for oil-fired wet central heating systems *(continued)*			
Oil-fired wet heating	**New systems**	**Replacement systems**	**Supplementary information**
4.0 System preparation and water treatment	a. Central heating systems should be thoroughly cleaned and flushed out before installing a new boiler. b. During final filling of the system, a chemical water treatment inhibitor meeting the manufacturer's specification or other appropriate standard should be added to the primary circuit to control corrosion and the formation of scale and sludge. c. Installers should also refer to the boiler manufacturer's installation instructions for appropriate treatment products and special requirements for individual boiler models. d. Where the mains total water hardness exceeds 200 parts per million, and if required by the manufacturer, provisions should be made to treat the feed water to water heaters and the hot water circuit of combination boilers to reduce the rate of accumulation of limescale.	a. As for ***new systems***.	*Inhibitors should as a minimum be BuildCert approved.* *Limescale can be controlled by the use of chemical limescale inhibitors, combined corrosion and limescale inhibitors, polyphosphate dosing, electrolytic scale reducers or water softeners.* *The relevant standard for water treatment is BS 7593:2006 "Code of practice for treatment of water in domestic hot water central heating systems".* *BS 7593 notes that soft water has an increased potential for corrosion, and this may influence the choice of corrosion inhibitor. Where water is artificially softened, it is advisable to feed unsoftened water not only to drinking water taps, but also to the boiler primary circuit. In soft water areas, the boiler manufacturer should be consulted for advice.*

Table 9: Recommended minimum standards for efficiency, system circulation, hot water storage, system preparation and commissioning for oil-fired wet central heating systems *(continued)*			
Oil-fired wet heating	**New systems**	**Replacement systems**	**Supplementary information**
4.0 System preparation and water treatment *(continued)*	e. For solar thermal systems, see Section 11.		*In order to avoid loss and consequent replacement of circulating fluid and water treatment when removing radiators for service or maintenance, it is advisable to install radiator valves that can isolate not only the heating circuit but also seal off the radiators.*
5.0 Commis-sioning	a. On completion of the installation of a boiler or a hot water storage system, together with associated equipment such as pipework, pumps and controls, the equipment should be commissioned in accordance with the manufacturer's instructions. These instructions will be specific to the particular boiler or hot water storage system. b. The installer should give a full explanation of the system and its operation to the user, including the manufacturer's user manual where provided.	a. As for ***new systems***.	*The Oil Controlled Document System (as produced and managed by OFTEC) can be used to show that oil-fired appliances and related systems have been installed and commissioned satisfactorily by listing and recording works and checks which are deemed necessary for the efficient operation of the appliance and system in compliance with the Building Regulations. A copy of each completed form is left with the householder or agent for record and/or Building Control inspection purposes, and a copy is retained by the issuing installer and engineer.*

Table 9: Recommended minimum standards for efficiency, system circulation, hot water storage, system preparation and commissioning for oil-fired wet central heating systems *(continued)*			
Oil-fired wet heating	**New systems**	**Replacement systems**	**Supplementary information**
5.0 Commissioning *(continued)*			*OFTEC branded forms are provided for the use of OFTEC Registered Competent Persons and non-OFTEC branded forms are available for others carrying out oil-fired installation and commissioning works. To assist installers OFTEC oil appliance manufacturing members may provide forms CD/10 & CD/11 or equivalent "Boiler Passport" with their equipment.* ***Controlled Document CD/10*** *Installing engineers should complete OFTEC Form CD/10 to show that they have compliantly completed the installation of an oil-fired appliance and controls, and wet system commissioning prior to final appliance commissioning.* ***Controlled Document CD/11*** *Commissioning engineers of oil-fired appliances should complete OFTEC Form CD/11 to record and show that they have completed the commissioning of the appliance and that they have left it operating in a safe and efficient manner.*

Table 10: Recommended minimum standards for control of oil-fired wet central heating systems		
Oil-fired wet heating	**New systems**	**Replacement systems**
1.0 Boiler interlock	a. Boiler-based systems should have a boiler control interlock in which controls are wired so that when there is no demand for either space heating or hot water, the boiler and pump are switched off. b. The use of thermostatic radiator valves (TRVs) alone does not provide interlock.	a. As for ***new systems***.
2.0 Space heating zones	a. Dwellings with a total usable floor area up to 150 m^2 should be divided into at least two space heating zones with independent temperature control, one of which is assigned to the living area. b. Dwellings with a total usable floor area greater than 150 m^2 should be provided with at least two space heating zones, each having separate timing and temperature controls. c. For single-storey open-plan dwellings in which the living area is greater than 70% of the total floor area, sub-zoning of temperature control is not appropriate.	a. As for ***new systems***.
3.0 Water heating zones	a. All dwellings should have a separate hot water zone in addition to space heating zones. b. A separate hot water zone is not required if the hot water is produced instantaneously, such as with a combination boiler.	a. As for ***new systems***.

Table 10: Recommended minimum standards for control of oil-fired wet central heating systems *(continued)*		
Oil-fired wet heating	**New systems**	**Replacement systems**
4.0 Time control of space and water heating	a. Time control of space and water heating should be provided by: i. a full programmer with separate timing to each circuit; ii. two or more separate timers providing timing control to each circuit; or iii. programmable room thermostat(s) to the heating circuit(s), with separate timing of the hot water circuit. b. For dwellings with a total usable floor area greater than 150 m^2, timing of the separate space heating zones can be achieved by: iv. multiple heating zone programmers; or v. a single multi-channel programmer; or vi. programmable room thermostats; or vii. separate timers to each circuit; or viii. a combination of (iii) and (iv) above. c. Where the hot water is produced instantaneously, such as with a combination boiler, time control is only required for space heating zones.	a. As for ***new systems*** unless only the hot water cylinder is being replaced and separate time control for the hot water circuit is not present. In this case it is acceptable to have a single timing control for both space heating and hot water.

Table 10: Recommended minimum standards for control of oil-fired wet central heating systems *(continued)*		
Oil-fired wet heating	**New systems**	**Replacement systems**
5.0 Temperature control of space heating	a. Separate temperature control of zones within the dwelling should be provided using: i. room thermostats or programmable room thermostats in all zones; and ii. individual radiator controls such as thermostatic radiator valves (TRVs) on all radiators other than in the reference rooms (with thermostat) and bathrooms.	a. As for ***new systems***.*
6.0 Temperature control of domestic hot water	a. Domestic hot water systems should be provided with a cylinder thermostat and a zone valve or three-port valve to control the temperature of stored hot water. b. In dwellings with a total floor area greater than 150 m^2 it would be reasonable to provide more than one hot water circuit, each with separate timing and temperature controls. This can be achieved by: i. multiple heating zone programmers; or ii. a single multi-channel programmer; or iii. separate timers to each circuit. c. Non-electric hot water controllers should not be used. Also, in some circumstances, such as with thermal stores, a zone valve is not appropriate; a second pump could be substituted for the zone valve.	a. As for ***new systems*** for planned replacement of hot water cylinders on all fully pumped installations, and on gravity circulation installations. b. In exceptional circumstances, such as emergency replacement or where the cylinder or installation is of a type that precludes the fitting of wired controls, either a wireless or thermomechanical hot water cylinder thermostat would be acceptable.

Table 10: Recommended minimum standards for control of oil-fired wet central heating systems *(continued)*		
Oil-fired wet heating	**New systems**	**Replacement systems**
Supplementary information *More details on control systems can be found in manufacturers' literature and on the The Association of Controls Manufacturers (TACMA) website at www.heatingcontrols.org.uk.* *Controls may be provided by any boiler management control system that meets the specified zoning, timing and temperature and boiler interlock control requirements.* **When an individual system component – such as the boiler or a room thermostat – is being replaced, it is not necessary to upgrade the whole system. However, while not essential for compliance with building regulations, in the case of a boiler replacement, because the system has to be drained down, it would be good practice to install thermostatic radiator valves (or equivalent) on all radiators other than in the room with the main thermostat, provided the radiators are suitable and pipework does not need to be altered.*		

Table 11: Recommended minimum standards for insulation of pipework in oil-fired wet central heating systems

New systems	**Supplementary information**	
a. Pipes should be insulated to comply with the maximum permissible heat loss indicated in the Supplementary Information column, and labelled accordingly, as follows: i. Primary circulation pipes for heating and hot water circuits should be insulated wherever they pass outside the heated living space or through voids which communicate with and are ventilated from unheated spaces. ii. Primary circulation pipes for domestic hot water circuits should be insulated throughout their length, subject only to practical constraints imposed by the need to penetrate joists and other structural elements. iii. All pipes connected to hot water storage vessels, including the vent pipe, should be insulated for at least 1 metre from their points of connection to the cylinder (or they should be insulated up to the point where they become concealed). iv. If secondary circulation is used, all pipes kept hot by that circulation should be insulated.	***Insulation of pipework in unheated areas*** *Extra provision may need to be made to protect central heating and hot water pipework in unheated areas against freezing. Guidance is available in:* • *BS 5422:2009 "Method for specifying thermal insulating materials for pipes, tanks, vessels, ductwork and equipment operating within the temperature range -40°C to +700°C".* • *BRE Report No 262 "Thermal insulation: avoiding risks", 2002 Edition.*	
	Where insulation is labelled as complying with this guide, it must not exceed the following heat loss levels:	
	Pipe outside diameter	***Maximum heat loss****
Replacement systems	*8 mm*	*7.06 W/m*
a. Whenever a boiler or hot water storage vessel is replaced in an existing system, any pipes that are exposed as part of the work or are otherwise accessible should be insulated as recommended above – or to some lesser standard where practical constraints dictate.	*10 mm*	*7.23 W/m*
	12 mm	*7.35 W/m*
	15 mm	*7.89 W/m*
	22 mm	*9.12 W/m*
	28 mm	*10.07 W/m*
	35 mm	*11.08 W/m*
	42 mm	*12.19 W/m*
	54 mm	*14.12 W/m*
	**In assessing the thickness of insulation required, standardised conditions should be assumed in all compliance calculations, based on a horizontal pipe at 60°C in still air at 15°C. Further guidance on converting heat loss limits to insulation thickness for specific thermal conductivities is available in TIMSA "HVAC guidance for achieving compliance with Part L of the Building Regulations".*	

3.3 Oil-fired range cookers with integral central heating boilers

This section provides guidance on the specification of oil-fired range cookers with integral central heating boilers for space heating and hot water in dwellings.

Note that the guidance applies only to twin-burner cooker boilers, which should not be confused with the type of range cooker described as a single burner "dry heat" range cooker. The latter is intended only to provide a cooking function, is not included in SAP 2009 calculations, and does not come within the scope of building regulations energy efficiency requirements.

Oil-fired range cookers with an integral central heating boiler which are provided as ***new systems*** and as ***replacement systems*** should meet the following conditions:

a. the appliance should have two independently controlled burners (one for the cooking function and one for the boiler)

b. the integral boiler should have a seasonal efficiency (SEDBUK 2005 or SEDBUK 2009) in excess of 80 per cent

c. the manufacturer's declaration of appliance performance and SEDBUK value should include the following words:

   i. seasonal efficiency (SEDBUK) = xx%

   ii. case heat emission value = yy kW

   iii. heat transfer to water at full load = zz kW

   iv. the efficiency values may be used in the UK Government's Standard Assessment Procedure (SAP) for the energy rating of dwellings. The test data from which they have been calculated has been certified by {insert name and/or identification of Notified body}. See www.rangeefficiency.org.uk.

   If the integral boiler is a condensing boiler, the declaration should make clear whether the efficiency has been calculated in accordance with SEDBUK 2005 or SEDBUK 2009. If it does not, then SEDBUK 2005 must be assumed.

d. the integral boiler should meet the minimum standards for oil-fired central heating systems in Tables 9, 10 and 11 for system circulation, hot water storage, system preparation, commissioning, controls and insulation.

3.4 Continually-burning oil-fired vaporising appliances providing secondary heating or hot water

This section provides guidance on the specification of oil-fired vaporising appliances providing heating or hot water for dwellings.

The guidance does not apply to appliances which have been converted from another fuel (for example from solid fuel to oil).

Oil-fired vaporising appliances provided as ***new systems*** or ***replacement systems*** should meet the minimum standards for controls in Table 12:

Table 12: Recommended minimum standards for control of continually-burning oil-fired vaporising appliances

Appliance type	New and replacement systems	Supplementary information
a. Manually operated appliance, e.g. room heater.	The integral manual controls as provided by appliance manufacturer.	*Information about the use of controls should be clearly stated in the manufacturer's literature.*
b. Electrically operated (modulating) appliance, e.g. room heater.	The integral or remote thermostatic controls as provided (or specified) by the appliance manufacturer.	
Automatic ON/OFF vaporising appliances		
c. Room heater providing (secondary) room space heating.	The integral thermostatic controls as provided by appliance manufacturer.	
d. Room heater providing domestic hot water & (secondary) room space heating.	The integral or remote thermostatic controls as provided (or specified) by the appliance manufacturer.	

3.5 Oil-fired fixed independent space heating appliances

This section provides guidance on the specification of oil-fired fixed independent space heating appliances for dwellings.

Fixed independent space heating appliances may be installed as a means of primary or secondary space heating.

Oil-fired fixed independent appliances for primary heating

Oil-fired fixed independent space heating appliances in new dwellings which are provided as the primary heat source should meet the following conditions:

a. The efficiency of the appliance (gross calorific value) should be not less than 60%. The appliance manufacturer's declaration of appliance performance should include the following words:

The net efficiency of this appliance has been measured as specified in OFS A102:2004 and the result after conversion to gross using the appropriate factor from Table E4 of SAP 2009 is [x]%. The test data been certified by {insert name and/or identification of Notified Body}. The efficiency value may be used in the UK Government's Standard Assessment Procedure (SAP) for energy rating of dwellings.

b. Each appliance should be capable, either independently or in conjunction with room thermostats or other suitable temperature sensing devices, of controlling the temperatures independently in areas that have different heating needs (e.g. separate sleeping and living areas).

Oil-fired fixed independent appliances for secondary heating

Oil-fired fixed independent space heating appliances in new dwellings which are provided as the secondary heat source should have a minimum efficiency (gross calorific value) of not less than 60 per cent.

Supplementary information

Further guidance on oil-fired heating systems is available in the following publications:

- *Energy Efficiency Best Practice in Housing publications (see www.oftec.org)*
- *CE29 "Domestic heating by oil: boiler systems"*
- *CE51 "Central heating system specifications (CHeSS)"*
- *CE54 "Whole house boiler sizing method for houses and flats"*
- *OFTEC Technical Books 2, 3, 4 and 5 (see www.oftec.org)*
- *BS EN 12828*
- *BS 5410 Part 1.*

Section 4

Electric heating systems

This section provides guidance on the specification of fixed electric heating systems for dwellings to meet relevant energy efficiency requirements in building regulations.

4.1 Scope of guidance

The guidance given in this section covers the following types of fixed electric heating systems:

- electric boilers serving central heating systems
- electric warm air systems
- electric panel heaters
- electric storage systems including integrated storage/direct systems.

Portable, plug-in appliances are not covered by building regulations or by this guide.

4.2 Electric boilers serving central heating systems

Electric boilers serving wet central heating provided as ***new systems*** or ***replacement systems*** in dwellings should meet the minimum standards for:

a. system circulation, system preparation and commissioning in Table 13

b. boiler interlock, zoning, and time control and temperature control of heating and hot water circuits in Table 14

c. hot water storage systems in Table 15

d. pipework insulation in Table 16.

Table 13: Recommended minimum standards for system circulation, preparation and commissioning for electric wet central heating systems			
Electric wet heating	**New systems**	**Replacement systems**	**Supplementary information**
1.0 System circulation	a. Systems for space heating and domestic hot water primary circuits in new dwellings should have fully pumped circulation. b. If the boiler manufacturer's instructions advise installation of a bypass, then an automatic bypass valve should be used.	As ***new systems***. When boilers are replaced, existing systems with semi-gravity circulation should be converted to fully pumped circulation.	
2.0 System preparation and water treatment	a. Central heating systems should be thoroughly cleaned and flushed before installing a new boiler. b. During final filling of the system a chemical water treatment formulation should be added to the primary circuit to control corrosion and the formation of scale and sludge. Reasonable provision would be to follow the guidance on how to prepare and commission systems given in BS7593:2006.	As for ***new systems***.	*Inhibitors should as a minimum be BuildCert approved.* *Limescale can be controlled by the use of chemical limescale inhibitors, combined corrosion and limescale inhibitors, polyphosphate dosing, electrolytic scale reducers or water softeners.* *The relevant standard for water treatment is BS 7593:2006 "Code of practice for treatment of water in domestic hot water central heating systems".*

Table 13: Recommended minimum standards for system circulation, preparation and commissioning for electric wet central heating systems *(continued)*			
Electric wet heating	**New systems**	**Replacement systems**	**Supplementary information**
2.0 System preparation and water treatment *(continued)*	c. Installers should also refer to the boiler manufacturer's installation instructions for appropriate treatment products and special requirements for individual boiler models. d. Where the mains total water hardness exceeds 200 parts per million, and if required by the manufacturer, provisions should be made to treat the feed water to water heaters and the hot water circuit of combination boilers to reduce the rate of accumulation of lime scale and the consequent reduction in energy efficiency.		*BS 7593 notes that soft water has an increased potential for corrosion, and this may influence the choice of corrosion inhibitor. Where water is artificially softened, it is advisable to feed unsoftened water not only to drinking water taps, but also to the boiler primary circuit. In soft water areas, the boiler manufacturer should be consulted for advice.* *In order to avoid loss and consequent replacement of circulating fluid and water treatment when removing radiators for service or maintenance, it is advisable to install radiator valves that can isolate not only the heating circuit but also seal off the radiators.*
3.0 Commiss-ioning	a. Manufacturers' instructions for commissioning should be followed and a commissioning record should be completed to show compliance. b. The installer should give a full explanation of the system and its operation to the user, including the manufacturer's user manual where provided.	As for ***new systems***.	

Table 14: Recommended minimum standards for control of electric wet central heating systems		
Electric wet heating	**New systems**	**Replacement systems**
1.0 Boiler temperature control	a. The boiler should be fitted with a flow temperature control and be capable of modulating the power input to the primary water depending on space heating conditions.	As for ***new systems***.
2.0 Boiler interlock	a. If the boiler also supplies domestic hot water, the system should have a boiler interlock in which controls are wired so that when there is no call for heat from either the space heating or hot water circuits then the boiler and pump are switched off. The use of thermostatic radiator valves (TRVs) alone does not provide interlock.	As for ***new systems***.
3.0 Zoning	a. Dwellings with a total usable floor area up to 150 m^2 should be divided into at least two space heating zones with independent temperature control, one of which is assigned to the living area. b. Dwellings with a total usable floor area greater than 150 m^2 should be provided with at least two space heating zones, each having separate timing and temperature controls. c. For single-storey open-plan dwellings in which the living area is greater than 70% of the total floor area, sub-zoning of temperature control is not appropriate.	As for ***new systems***.

Table 14: Recommended minimum standards for control of electric wet central heating systems *(continued)*		
Electric wet heating	**New systems**	**Replacement systems**
4.0 Temperature control of space heating	a. Separate temperature control of zones within the dwelling should be provided, using: i. room thermostats or programmable room thermostats in all zones; and ii. individual radiator controls such as thermostatic radiator valves (TRVs) on all radiators other than in reference rooms (with a thermostat) and bathrooms.	As for ***new systems***.*
5.0 Time control of space and water heating	a. Time control of space and water heating should be provided by: i. a full programmer with separate timing to each circuit; i. two or more separate timers providing itiming control to each circuit; or iii. programmable room thermostat(s) to the heating circuit(s), with separate timing of the hot water circuit.	As for ***new systems***.
Supplementary information *More details on control systems can be found in manufacturers' literature and on the The Association of Controls Manufacturers (TACMA) website at www.heatingcontrols.org.uk.* *Controls may be provided by any boiler management control system that meets the specified zoning, timing and temperature and boiler interlock control requirements.* **When an individual system component – such as the boiler or a room thermostat – is being replaced, it is not necessary to upgrade the whole system. However, while not essential for compliance with building regulations, in the case of a boiler replacement, because the system has to be drained down, it would be good practice to install thermostatic radiator valves (or equivalent) on all radiators other than in the room with the main thermostat, provided the radiators are suitable and pipework does not need to be altered.*		

Table 15: Recommended minimum standards for hot water storage in electric wet central heating systems		
Electric wet heating	**New and replacement systems**	**Supplementary information**
1.0 Vented systems – including cylinders heated primarily by electricity	a. Vented copper hot water storage vessels should comply with BS 1566 or BS 3198. b. Vented cylinders in materials other than copper should also be labelled as complying with the heat loss requirements of BS 1566. c. For vented ***replacement systems***, electrically heated combination units should be insulated such that the heat loss does not exceed the value $Q = 1.28 \times (0.2+0.051V^{2/3})$ kWh/day, where V is the nominal cylinder volume in litres. This applies to electrically heated combination units as well as other electrically heated cylinders. d. For vented ***new systems***, electrically heated combination units should be insulated such that the heat loss does not exceed the value $Q = 1.15 \times (0.2+0.051V^{2/3})$ kWh/day, where V is the nominal cylinder volume in litres. This applies to electrically heated combination units as well as other electrically heated cylinders.	***British Standards*** *BS 1566: 2002 "Copper indirect cylinders for domestic purposes. Open vented copper cylinders. Requirements and test methods".* *BS 3198:1981 "Specification for copper hot water storage combination units for domestic purposes".* *BS EN 12897 "Water supply. Specification for indirectly heated unvented (closed) storage water heaters".*

Table 15: Recommended minimum standards for hot water storage in electric wet central heating systems *(continued)*		
Electric wet heating	**New and replacement systems**	**Supplementary information**
2.0 Unvented systems – including cylinders heated primarily by electricity	a. Products should either comply with BS EN 12897, or be certified by the British Board of Agrément, Water Research Council or other accredited body as complying with building regulations. b. Cylinders heated primarily by electricity should be insulated such that their heat loss does not exceed $Q = 1.15 \times (0.2+0.051V^{2/3})$ kWh/day, where V is the nominal cylinder volume in litres. This applies to electrically heated combination units as well as other electrically heated cylinders.	
3.0 Vented and unvented systems	a. Cylinders should either be factory fitted with, or have provision for, two thermostatically controlled electrical heating elements or immersion heaters. b. The lower element should be capable of heating up at least 85% of the cylinder contents. c. The upper element should be capable of heating at least 60 litres of water. d. The lower element should be connected to utilise the "off peak" electricity tariff and the upper for boost operation. e. The vessel should be designed such that following reheating to 60°C from the off peak element, at least 80% of the contents can be drawn off at 45°C or above at a flow rate of 0.25 l/s.	

Table 15: Recommended minimum standards for hot water storage in electric wet central heating systems *(continued)*		
Electric wet heating	**New and replacement systems**	**Supplementary information**
4.0 Primary stores	a. Primary storage systems should meet the insulation requirements of the Hot Water Association *Performance specification for thermal stores*. b. Unvented hot water storage system products should comply with BS EN 12897:2006 or an equivalent standard as set by an accredited test body such as the British Board of Agrément, the Water Research Council, or KIWA	
5.0 Labelling	a. All hot water storage vessels should carry a label with the following information: i. type of vessel; ii. nominal capacity in litres; iii. standing heat loss in kWh/day; iv. heat exchanger performance in kW. b. Vented copper hot water cylinders should carry clear labelling on the product such as a BSI Kitemark, registered firm status or reference to an equivalent quality control scheme. c. Vented cylinders which are not of copper construction should be labelled as complying with the heat loss and heat exchanger requirements of BS 1566. d. For labelling of hot water storage vessels in solar thermal systems, see Section 11, *Solar water heating*.	

Table 16: Recommended minimum standards for insulation of pipework in central heating systems with electric boilers

New systems	**Supplementary information**
a. Pipes should be insulated to comply with the maximum permissible heat loss indicated in the Supplementary Information column, and labelled accordingly, as follows: i. Primary circulation pipes for heating and hot water circuits should be insulated wherever they pass outside the heated living space or through voids which communicate with and are ventilated from unheated spaces. ii. Primary circulation pipes for domestic hot water circuits should be insulated throughout their length, subject only to practical constraints imposed by the need to penetrate joists and other structural elements. iii. All pipes connected to hot water storage vessels, including the vent pipe, should be insulated for at least 1 metre from their points of connection to the cylinder (or they should be insulated up to the point where they become concealed). iv. If secondary circulation is used, all pipes kept hot by that circulation should be insulated.	***Insulation of pipework in unheated areas*** *Extra provision may need to be made to protect central heating and hot water pipework in unheated areas against freezing. Guidance is available in:* • *BS 5422:2009 "Method for specifying thermal insulating materials for pipes, tanks, vessels, ductwork and equipment operating within the temperature range -40°C to +700°C".* • *BRE Report No 262 "Thermal insulation: avoiding risks", 2002 Edition.*
Replacement systems	*Where insulation is labelled as complying with this guide, it must not exceed the following heat loss levels:*
a. Whenever a boiler or hot water storage vessel is replaced in an existing system, any pipes that are exposed as part of the work or are otherwise accessible should be insulated as recommended above – or to some lesser standard where practical constraints dictate.	

Pipe outside diameter	***Maximum heat loss****
8 mm	*7.06 W/m*
10 mm	*7.23 W/m*
12 mm	*7.35 W/m*
15 mm	*7.89 W/m*
22 mm	*9.12 W/m*
28 mm	*10.07 W/m*
35 mm	*11.08 W/m*
42 mm	*12.19 W/m*
54 mm	*14.12 W/m*

**In assessing the thickness of insulation required, standardised conditions should be assumed in all compliance calculations, based on a horizontal pipe at 60°C in still air at 15°C. Further guidance on converting heat loss limits to insulation thickness for specific thermal conductivities is available in TIMSA "HVAC guidance for achieving compliance with Part L of the Building Regulations".*

4.3 Electric heating systems (other than electric boilers for central heating)

This section provides guidance on the following types of fixed electric heating systems:

- electric warm air systems
- electric panel heaters
- electric storage systems including integrated storage/direct systems.

Portable, plug-in appliances are not covered by this guide.

Fixed electric heating systems (other than electric boilers) provided as ***new systems*** and ***replacement systems*** should meet the minimum standards for time and temperature control in Table 17.

Table 17: Recommended minimum standards for control of primary and secondary electric heating systems (other than with electric boilers)			
Electric heating systems	**New and replacement systems**		**Supplementary information**
Warm air systems	**1.0 Time and temperature control, either integral to the heater or external**	a. Time switch/programmer and room thermostat; or b. programmable room thermostat .	
	2.0 Zone control	a. Dwellings with a total usable floor area up to 150 m^2 should be divided into at least two space heating zones with independent temperature control, one of which is assigned to the living area. b. Dwellings with a total usable floor area greater than 150 m^2 should be provided with at least two space heating zones, each having separate timing and temperature controls. Time control should be provided by: i. multiple heating zone programmers; or ii. a single multi-channel programmer, or iii. programmable room thermostats, or iv. separate timers to each circuit, or v. ia combination of (iii) and (iv) above. c. For single-storey open-plan dwellings in which the living area is greater than 70% of the total floor area, sub-zoning of temperature control is not appropriate.	

Table 17: Recommended minimum standards for control of primary and secondary electric heating systems (other than with electric boilers) *(continued)*			
Electric heating systems	**New and replacement systems**		**Supplementary information**
Panel heaters	**3.0 Local time and temperature control**	a. Time control by a programmable time switch integrated into the appliance or a separate time switch. b. Individual temperature control by integral thermostats or by separate room thermostats or programmable room thermostats.	*Panel heater systems provide instantaneous heat.*
Storage heaters	**4.0 Charge control**	a. Automatic control of input charge.	*Charge control is the ability to detect the internal temperature and adjust the charging of the heater accordingly.*
	5.0 Temperature control	a. Temperature control by adjusting the rate of heat release from the appliance, using an adjustable damper or other thermostatically-controlled method.	

Section 5

Solid fuel heating systems

5.1 Scope of guidance

This section provides guidance on meeting the energy efficiency standards in building regulations for the following types of solid fuel heating appliances and systems used to deliver primary and secondary heating:

- batch-fed open fires
- batch-fed and automatic-feed dry room heaters/stoves
- batch-fed log and multi-fuel appliances
- automatic-feed pellet stoves with and without boilers
- batch-fed and automatic-feed room heaters with boilers
- batch-fed cookers with boilers not exceeding 7.5 kW
- batch-fed independent boilers and automatic-feed anthracite, wood pellet, wood chip and wood log fired independent boilers
- central heating systems using certain types of solid fuel appliances.

The guidance covers the following types of solid fuel: coal, anthracite, manufactured smokeless fuel, dual-fuel, wood logs, wood pellets and wood chips.

5.2 Solid fuel appliances for primary heating

Solid fuel appliances provided as ***new systems*** and ***replacement systems*** in dwellings for primary heating should have an efficiency (gross calorific value) not less than specified in Table 18 for that category of appliance.

Table 18: Solid fuel appliance categories and recommended minimum efficiencies

Category	Appliance description	Minimum efficiency (gross calorific value)	Feed
B1	Simple open fire – Inset	37%	Batch
B2	Open fire – freestanding convector	47%	Batch
B3	Open fire inset convector	45% (mineral fuels) 43% (wood fuels)	
C1/2	Open fire and boiler(inset or freestanding)	50%	Batch
D1/2/3	Open fire + high output boiler (trapezium and rectangular grates)	63%	Batch
D4	Open fire + high output boiler (rectangle)	63%	Batch
E 1	Dry room heater (often known as dry stove)	65%	Batch/ Automatic
E 2	Dry room heater – logs only	65%	Batch
E 3	Dry room heater – multi-fuel	65%	Batch
E 4	Dry room heater – pellet stove	65% part load 70% nominal load	Auto
F	Room heater with boiler	67%(mineral fuels and logs) 70% (wood pellets – part load) 75% (wood pellets – nominal load)	Batch/ Automatic
G1	Cooker without boiler not exceeding 3.5 kW	65% (mineral fuels) 55% (wood fuels)	Batch
G2	Cooker with heating boiler exceeding 3.5 kW	65% (mineral fuels) 60% (wood fuels)	Batch
J2	Independent boiler (batch-fed) wood logs only	75%	Batch
J3	Independent boiler (batch-fed) multi-fuel	65% (mineral fuels) 75% (wood logs)	Batch
J4	Independent boiler – anthracite	70% up to 20.5 kW 75% above 20.5 kW	Automatic
J5	Independent boiler – wood/pellets/chips	75% nominal load 70% part load	Automatic
	Slow heat release appliances	65%	Batch
	One-off tiled/mortared stoves	70%	Batch

Supplementary information on solid fuel appliances

Minimum efficiencies

Minimum efficiencies for solid fuel appliances are published in the HETAS "Official guide to approved solid fuel products and services", and on the website www.hetas.co.uk. Manufacturers' efficiency figures may be higher than those indicated and should be used where independently certified against the harmonised European Standards now in place.

Carbon emission factors

Solid fuels include wood in various forms, different types of coal, and manufactured solid fuels, and consequently there is a range of associated CO_2 emission factors. These factors are as important as appliance efficiency when selecting a boiler. Table 19 shows the CO_2 emission factors for generic types of solid fuel recognised in SAP.

Table 19: CO_2 emission factors for generic types of solid fuel

Solid fuel	***Solid Fuel CO_2 emission factors*** (kg CO_2/kWh)	**Notes**
House Coal	*0.301*	*Traditional British coal. It burns with smoky flame*
Anthracite	*0.318*	*A mineral fuel with high carbon content. Burns very cleanly*
Manufactured smokeless fuel	*0.347*	*Mineral fuel usually made from anthracite*
Wood logs	*0.008*	*Renewable wood logs either purchased or from own land*
Wood pellets in bags	*0.028*	*Mechanically compressed sawdust*
Bulk wood pellets	*0.028*	*As above, delivered in bulk*
Wood chips	*0.009*	*Chipped wood, processed on site*
Dual-fuel	*0.206*	*A UK "typical blend" of logs and mineral fuel as burnt by a typical householder on a dual-fuel stove*

Smoke Control Areas

Within local authority Smoke Control Areas only anthracite or other Authorised Smokeless Fuels may be used, unless the property is fitted with an Exempted Appliance. An exempted appliance is one that has been approved by Parliamentary Statutory Instrument for installation in smoke control areas and prospective purchasers should check that the appliance and intended fuel are permitted. A list of currently authorised fuels and exempted appliances is given on the web site www.uksmokecontrolareas.co.uk.

Supplementary information on solid fuel appliances *(continued)*
Outside a smoke control area house coal or wood can be burnt on non-exempted appliances. Wood should always be seasoned to a moisture content appropriate to the design and performance of the appliance, for example log wood not exceeding 20% to ensure maximum performance and limit the occurrence of condensation and deposits in the chimney system.
All solid fuel appliances require appropriate soot-fire resistant chimneys discharging at high level locations as defined within building regulations. Details of HETAS-approved chimney products independently tested and approved to accepted standards can be found on the HETAS website. The natural ventilation rates of these chimneys may be less than the default values listed within SAP 2009; the use of these more accurate values will reduce SAP values.

5.3 Central heating systems using certain types of solid fuel appliances

This section provides guidance on the following types of solid fuel appliance used to deliver primary heating as part of a central heating system:

- batch-fed open fires with high output boilers (appliance types D1 to D4 in Table 18)
- batch-fed and automatic-feed room heaters and stoves with boilers (appliance type F in Table 18)
- batch-fed cookers with boilers (appliance type G2 in Table 18)
- batch-fed independent boilers and automatic-feed anthracite, wood log, wood pellet and wood chip fired independent boilers (appliance types J1 to J5 in Table 18).

Unless stated otherwise, the guidance applies equally to appliances that burn wood, wood pellets, house coal, manufactured smokeless fuels and anthracite.

For central heating systems with a solid fuel appliance installed as a ***new system*** or ***replacement system*** in dwellings:

a. the appliance should be from HETAS categories D, F, G and J in Table 18 and have a minimum efficiency (gross calorific value) which is not less than the value specified for its category

b. the ratio of room heat to water heat should be appropriate for the room and total property. This will require reference to installation practice guidelines and calculation of room and property heat loss. Advice on this is given in the HETAS Guide and website

c. circulation, fuel storage, hot water storage, system preparation, water treatment and commissioning should be to the standards in Table 20

d. control of heating and hot water circuits should be to the standards in Table 21

e. pipework should be insulated to the standards in Table 22.

Supplementary information

Turn-down values (i.e. the ratio of high to low output)

a. Turn-down ratios are generally very good (>10:1) for automatic-feed appliances with small firebeds.
b. Turn-down ratios are less good with large batch-fed appliances unless the latter are used in conjunction with a hot water accumulator.
c. Automatic appliances are likely to require less frequent refuelling. Automatic (e.g. electric or gas) ignition is now available for certain designs and reduces energy usage at times of low demand allowing boiler interlock.
d. Some boilers have both auto-ignition and fire-extinguishing features.

Link-up systems

It is possible to connect together two or more heating appliances with boilers (at least one of which can be solid fuel-fired), to maximise flexibility and efficiency. For example, an oil or gas boiler could be combined with a wood burning stove with boiler sited in the living room. This combination with wood burning appliances will reduce overall carbon emissions. Both systems should be designed to appropriate installation codes.

Table 20: Recommended minimum standards for system circulation, fuel storage, hot water storage, system preparation and commissioning for solid fuel central heating		
Solid fuel heating	**New and replacement systems**	**Supplementary information**
1.0 System circulation	a. Where boiler interlock is available, fully pumped circulation should be chosen. b. The manufacturer's instructions on the sizing and positioning of heat leak radiators should be followed. c. Solid fuel appliances should not be fitted to sealed heating systems with expansion vessels, except where specifically permitted by the manufacturer or where a thermal storage interface device is used.	*Most solid fuel central heating systems require a heat leak radiator to dissipate heat from the smouldering fire bed. This is commonly the bathroom towel-rail and a thermosiphon system may be used for this circuit. In some cases a fully pumped system reduces efficiency and should not be used.*
2.0 Fuel storage	a. Provision should be made for storage of reasonable quantities of fuel in a convenient and dry location. The size of the storage will depend upon the requirement of the house.	*No minimum quantity of fuel is specified for solid mineral fuel but bunkers greater than 250 kg are preferred as below this householders are likely to pay a delivery premium.*

Table 20: Recommended minimum standards for system circulation, fuel storage, hot water storage, system preparation and commissioning for solid fuel central heating *(continued)*		
Solid fuel heating	**New and replacement systems**	**Supplementary information**
3.0 Hot water storage	a. Vented copper hot water storage vessels should comply with the heat loss and heat exchanger requirements of BS 1566-1:2000 or BS 3198. b. Vented cylinders in materials other than copper should comply with the heat loss and heat exchanger requirements of BS 1566. c. Unvented hot water storage system products should: i. comply with BS EN 12897 ; or ii. be certified by the British Board of Agrément, the Water Research Council; or iii. be certified by another accredited body as complying with building regulations. d. Unvented systems should not be used with gravity circulation. e. Primary storage systems should meet the insulation requirements of section 4.3.1 or 4.3.2 of the Hot Water Association *Performance specification for thermal stores*. f. Combination cylinders should comply with BS 3198 and in addition have a heat loss not exceeding 1.6 x [0.2 + 0.51$V^{2/3}$] kWh/day where V is the volume of the hot water part of the cylinder.	***Primary hot water stores*** *These can have a major role to play in the installation of solid fuel. The main reason for their use is to store the heat generated during slumber periods, but where unvented storage cylinders are used they also provide mains pressure hot water and possible frost protection (via electric immersion heaters) for the solid fuel system. Domestic hot water outlet temperature is to be controlled at a safe level. Because of the higher than normal storage temperatures it is very important that stores are well insulated.* *The HWA thermal storage specification is available for free download from www.hotwater.org.uk.* ***British Standards*** *BS 1566: 2002 "Copper indirect cylinders for domestic purposes. Open vented copper cylinders. Requirements and test methods".* *BS 3198:1981 "Specification for copper hot water storage combination units for domestic purposes".* *BS EN 12897 "Water supply. Specification for indirectly heated unvented (closed) storage water heaters".*

Table 20: Recommended minimum standards for system circulation, fuel storage, hot water storage, system preparation and commissioning for solid fuel central heating *(continued)*		
Solid fuel heating	**New and replacement systems**	**Supplementary information**
	g. All hot water storage vessels should carry a label with the following information: i. type of vessel; ii. nominal capacity in litres; iii. standing heat loss in kWh/day; iv. type of vessel; v. heat exchanger performance in kW. h. Vented copper hot water cylinders should carry clear labelling on the product such as a BSI Kitemark, registered firm status or reference to an equivalent quality control scheme.	
4.0 System preparation and water treatment	a. Central heating systems should be thoroughly cleaned and flushed out before installing a new boiler. b. During final filling of the system a chemical water treatment formulation should be added to the primary circuit to control corrosion and the formation of scale and sludge. Reasonable provision would be to follow the guidance on how to prepare and commission systems given in BS 7593:2006. c. Installers should also refer to the boiler manufacturer's installation instructions for appropriate treatment products and special requirements for individual boiler models.	*BS 7593 notes that soft water has an increased potential for corrosion, and this may influence the choice of corrosion inhibitor. Where water is artificially softened, it is advisable to feed unsoftened water not only to drinking water taps, but also to the boiler primary circuit. In soft water areas, the boiler manufacturer should be consulted for advice on the choice of inhibitor.* *In order to avoid loss and consequent replacement of circulating fluid and water treatment when removing radiators for service or maintenance, it is advisable to install radiator valves that can isolate not only the heating circuit but also seal off the radiators.*

Table 20: Recommended minimum standards for system circulation, fuel storage, hot water storage, system preparation and commissioning for solid fuel central heating *(continued)*		
Solid fuel heating	**New and replacement systems**	**Supplementary information**
	d. Where the mains total water hardness exceeds 200 parts per million, and if required by the manufacturer, provision should be made to treat the feed water to water heaters and the hot water circuit to reduce the rate of accumulation of lime scale and the consequent reduction in energy efficiency	
5.0 Commiss-sioning	a. On completion of the installation of a boiler or hot water storage system, together with associated equipment such as pipework, pumps and controls, the equipment should be commissioned in accordance with the manufacturer's instructions. These instructions will be specific to the particular boiler or hot water storage system used. b. The installer should give a full explanation of the system and its operation to the user, including the manufacturer's user manual where provided.	*Only persons who are competent should carry out the installation, e.g. installers who are registered with HETAS. Such persons will certify that they have carried out installation and commissioning in accordance with requirements in building regulations and in the manufacturer's instructions (which may be more stringent).* *Note that the delivery of wood or coal without appropriate documentation into a smoke-control area is an offence under the Clean Air Act.*

Table 21: Recommended minimum standards for control of solid fuel central heating systems			
Solid fuel heating	**New systems**	**Replacement systems**	**Supplementary information**
All appliances, except open fires			
1.0 Burning rate	a. Thermostatic control of the burning rate.	a. Thermostatic control of the burning rate.	
Automatic-feed appliances			
2.0 Zoning	a. Dwellings with a total usable floor area up to 150 m^2 should be divided into at least two space heating zones with independent temperature control, one of which is assigned to the living area. b. Dwellings with a total usable floor area greater than 150 m^2 should be provided with at least two space heating zones, each having separate timing and temperature controls. c. For single-storey, open-plan dwellings in which the living area is greater than 70% of the total floor area, sub-zoning of temperature control is not appropriate.	a. No minimum requirement but, as far as it is practicable and economic to do so, controls should be upgraded to the levels defined for ***new systems.***	
3.0 Time control of space and water heating	a. Time control of space and water heating should be provided by: i. a full programmer with separate timing to each circuit; or ii. two or more separate timers providing timing control to each circuit; or iii. programmable room thermostat(s) to the heating circuit(s), with separate timing of the hot water circuit.	a. No minimum requirement but, as far as it is practicable and economic to do so, controls should be upgraded to the levels defined for ***new systems***.	*The level of sophistication should generally be appropriate to and compatible with that of the appliance. The highest levels are only appropriate to appliances with automatic ignition.*

Table 21: Recommended minimum standards for control of solid fuel central heating systems *(continued)*			
Solid fuel heating	**New systems**	**Replacement systems**	**Supplementary information**
4.0 Temperature control of space heating	a. Separate temperature control of zones within the dwelling should be provided using: i. room thermostats or programmable room thermostats in all zones; and ii. individual radiator controls such as thermostatic radiator valves (TRVs) on all radiators other than in reference rooms and bathrooms.	a. No minimum requirement but, as far as it is practicable and economic to do so, controls should be upgraded to the levels defined for ***new systems***.	
5.0 Temperature control of domestic hot water	a. A cylinder thermostat and a zone valve or three-port valve should be fitted to control the temperature of stored hot water. b. Non-electric hot water controllers should not be used. c. Where permitted by the manufacturer, the cylinder thermostat should be wired to provide a boiler interlock.	a. A method of temperature control should be provided to prevent excessive tap water temperatures. b. As far as it is practicable and economic to do so, controls should be upgraded to the levels defined for ***new systems***.	*In some circumstances, such as with thermal stores, a zone valve is not appropriate; a second pump could be substituted for the zone valve.*

Supplementary information on controls for solid fuel central heating

Boiler interlock, provided by a wiring arrangement, to prevent the system from operating when there is no demand for heat, should only be fitted if recommended by the manufacturer.

In some simple batch-fed or automatic appliances (without heat stores or without automatic ignition), it is not possible to switch off the heat output completely, but the appliance output can be lowered to a minimum to reduce fuel consumption.

In most solid fuel systems the room thermostat will switch off the pump, which in turn will cause the boiler to operate at minimum output.

Some automatic solid fuel systems can be fitted with weather compensation, and incorporate multi-zone control. It is important to seek guidance from the manufacturer, especially if the heating package is to include other fuels.

Controls may be provided by any boiler management control system that meets the specified zoning, timing and temperature, and boiler interlock control requirements.

Table 22: Recommended minimum standards for insulation of pipework in solid fuel central heating systems

New systems	**Supplementary information**	
a. Pipes should be insulated to comply with the maximum permissible heat loss indicated in the Supplementary Information column, and labelled accordingly, as follows: i. Primary circulation pipes for heating and hot water circuits should be insulated wherever they pass outside the heated living space or through voids which communicate with and are ventilated from unheated spaces. ii. Primary circulation pipes for domestic hot water circuits should be insulated throughout their length, subject only to practical constraints imposed by the need to penetrate joists and other structural elements. iii. All pipes connected to hot water storage vessels, including the vent pipe, should be insulated for at least 1 metre from their points of connection to the cylinder (or they should be insulated up to the point where they become concealed). iv. If secondary circulation is used, all pipes kept hot by that circulation should be insulated.	***Insulation of pipework in unheated areas*** *Extra provision may need to be made to protect central heating and hot water pipework in unheated areas against freezing. Guidance is available in:* • *BS 5422:2009 "Method for specifying thermal insulating materials for pipes, tanks, vessels, ductwork and equipment operating within the temperature range -40°C to +700°C".* • *BRE Report No 262 "Thermal insulation: avoiding risks", 2002 Edition.*	
	Where insulation is labelled as complying with this guide, it must not exceed the following heat loss levels:	
	Pipe outside diameter	***Maximum heat loss****
Replacement systems	*8 mm*	*7.06 W/m*
a. Whenever a boiler or hot water storage vessel is replaced in an existing system, any pipes that are exposed as part of the work or are otherwise accessible should be insulated as recommended above – or to some lesser standard where practical constraints dictate.	*10 mm*	*7.23 W/m*
	12 mm	*7.35 W/m*
	15 mm	*7.89 W/m*
	22 mm	*9.12 W/m*
	28 mm	*10.07 W/m*
	35 mm	*11.08 W/m*
	42 mm	*12.19 W/m*
	54 mm	*14.12 W/m*
	**In assessing the thickness of insulation required, standardised conditions should be assumed in all compliance calculations, based on a horizontal pipe at 60°C in still air at 15°C. Further guidance on converting heat loss limits to insulation thickness for specific thermal conductivities is available in TIMSA "HVAC guidance for achieving compliance with Part L of the Building Regulations".*	

5.4 Solid fuel appliances for secondary heating

Solid fuel appliances in new and existing dwellings that are provided for secondary heating and are not part of a central heating system should have an efficiency (gross calorific value) not less than specified in Table 18 for that category of appliance.

Supplementary information on solid fuel appliances providing secondary heating

Minimum efficiencies

Minimum efficiencies for solid fuel appliances are published in the HETAS "Official guide to approved solid fuel products and services", and on the website www.hetas.co.uk. Manufacturers' efficiency figures may be higher than those indicated and should be used where independently certified against the harmonised European Standards now in place.

Appliance types

Appliances which are most suitable for secondary space heating are summarised in Table 23.

Table 23: Appliance types

Appliance type	Notes
Open fire with high output boiler, when used with "link-up".	
Small solid fuel room heaters (stoves), especially wood-fired.	*These can be a dedicated wood burner or burn logs in a multi-fuel appliance or use pellets. They can be matched with a main heating system fired by the same or a different primary fuel or off-peak electricity to reduce carbon emissions, especially wood-fired, with or without thermostatic control. Many designs can provide heating during power cuts. Mineral fuel appliances can be chosen but the attention of designers is drawn to the probable need to supply additional measures, as the carbon emission values of these tend to be high. Mineral fuel appliances may often have slightly higher efficiencies than their wood burning counterparts. Multi-fuel room heaters can enable the user to burn renewable wood as well as an alternative to mineral fuels outside smoke control areas.*
Small solid fuel stoves with boilers.	*The efficiency of these can be higher than that of dry appliances. They can be integrated with the primary wet heating system. Multi-fuel appliances enable the householder to burn renewable wood outside smoke control areas.*

Table 23: Appliance types *(continued)*	
Appliance type	**Notes**
Range cookers.	*Typically appliances which are installed in a "living area" and are designed to provide some useful heat from their case into the space in which they are located. They are available in a variety of shapes and sizes and can incorporate a boiler which can be connected to dual-fuel integrated systems (e.g. link-up). Multi-fuel versions are also available.*
Where requested, open fires (HETAS categories B1, B2 and B3) can be fitted.	*These do not have thermostatic control of the burning rate and have lower efficiencies. However, they are able to burn wood logs with correspondingly low net carbon emissions. It must be stressed that large open fires with large free face areas (see Note 1) usually have a need for ventilation well in excess of that available in a property built to modern standards of air tightness. This is likely to lead to severe operational problems unless special steps are taken to provide the required air supply. The use of such large (simple) open fires is penalised in the SAP calculations.* ***Note 1**: The free face area of an open fire is its opening width times its opening height.*

Controls for solid fuel appliances providing secondary heating

Wherever possible, solid fuel appliances should have thermostatic control (these are usually integral to appliances in categories E, F and G). Controls should be appropriate to the level of sophistication of the appliance; automatic appliances can benefit from advanced controls.

Provision of fuel storage for solid fuel appliances providing secondary heating

The quantity of fuel consumed by secondary heating appliances is likely to be less than 1 tonne per year. However it should be stored in a dry and convenient location.

Smoke control areas

The location of the appliance within or without a smoke control area is critical to the process of optimising the choice of appliance and fuel.

For further information on solid fuel appliances see CE47 "Energy Efficiency Best Practice in Housing – Domestic heating by solid fuel: Boiler systems".

Guidance and standards

EN 12809:2001/A1:2004/AC:2006/2007 "Residential Independent boilers fired by solid fuel – Nominal output up to 50kW – Requirements and test methods".

EN 12815:2001/A1:2004/2006/2007 "Residential cookers fired by solid fuel – Requirements and test methods".

EN 13229:2001/A1:2003/A2:2004/AC:2006/2007 "Inset appliances including open fires fired by solid fuel – Requirements and test methods".

EN 13240:2001/A2:2004 /AC2006/2007 "Room heaters fired by solid fuel – Requirements and test methods".

EN 15250:2007 "Slow heat release appliances fired by solid fuel – Requirements and test methods".

EN 15544 "One-off tiled/mortared stoves – Calculation method".

EN 14785:2006 "Residential space heating appliances fired by wood pellets".

Solid biofuels quality standards: CEN/TS 14588:2004; CEN/TS 14774-1:2004; CEN/TS 14774-2:2004; CEN/TS 14774-3:2004; CEN/TS 14775:2004; CEN/TS 14778-1:2005; CEN/TS 14778-2:2005; CEN/TS 14779:2005; CEN/TS 14780:2005; CEN/TS 14918:2005; CEN/TS 14961:2005; CEN/TS 15103:2005; CEN/TS 15148:2005; CEN/TS 15149-1:2006; CEN/TS 15149-2:2006; CEN/TS 15150:2005; CEN/TS 15210-1:2005; CEN/TS 15234:2006; CEN/TS 15289:2006; CEN/TS 15290:2006; CEN/TS 15296:2006.

Section 6

Community heating systems

6.1 Scope of guidance

This section provides guidance on the specification of community heating systems for dwellings to meet relevant energy efficiency requirements in building regulations.

A community heating system is one that supplies heat to a number of dwellings from a common heat source. A system may heat a small block of flats or a large number of buildings.

The guidance in this section applies to systems that:

- supply 15 or more dwellings from a central boiler, or from a low carbon source such as combined heat and power (CHP), biofuels, heat pumps and solar panels
- distribute heat from the central source using a wet radiator system (although warm air heating and underfloor heating systems may also be used).

6.2 New and existing community heating schemes

The central heat source should comply with the requirements in the *Non-domestic building services compliance guide* except where specified in this section.

Guidance is provided for two scenarios:

- connecting dwellings to a new community heating scheme
- connecting dwellings to an existing community heating scheme.

Connecting dwellings to a new community heating scheme

New community heating systems for both new and existing dwellings should meet the minimum standards for:

a. energy efficiency in Table 24

b. low-carbon heat sources in Table 25

c. system control in Table 26

d. hot water production, storage and treatment, heat metering and commissioning in Table 27

e. insulation of pipework in Table 28.

Connecting dwellings to an existing community heating scheme

When existing community heating systems are connected to new or existing dwellings, the minimum requirements are:

a. if the existing community heating system is in need of replacement or improvement, a study should be carried out to assess the economic and environmental benefits of a range of options, including the use of CHP and other low carbon heat sources, especially where individual heating systems are being considered as an alternative to continuing with the community heating system

b. replacement boilers should meet the minimum standards for boiler efficiency in the *Non-domestic building services compliance guide* (available from www.planningportal.gov.uk/approveddocuments > *Part L* > *Associated documents*)

c. if thermal energy is purchased from an existing district or community heating system, an assessment of the carbon intensity of the scheme should be carried out. Emission factors should be determined based on the particular details of the scheme, but should take account of the annual average performance of the whole system – that is, of the distribution circuits and all the heat generating plant, including any CHP, and any waste heat recovery or heat dumping. The calculation of the Dwelling CO_2 Emission Rate should be carried out by a suitably qualified person, who should explain how the emission factors were derived

d. controls should meet the minimum standards in Table 26

e. pipework insulation should meet the minimum standards in Table 28.

Table 24: Recommended minimum standards for the design of new community heating systems to maximise efficiency of heat generation and minimise energy use by pumps		
Community heating	**New systems**	**Supplementary information**
1.0 Boilers	a. Boiler-only community heating systems for new dwellings may be used provided that the Target carbon dioxide Emission Rate (TER) for the dwelling is not exceeded. b. Boilers should be selected to comply with the boiler efficiency requirements of the *Non-domestic building services compliance guide*.	*When calculating the carbon emission rate, the type and quantity of fuel used and also the electricity needed to operate the central plant and pumps should be taken into account.* *For systems using condensing boilers:* • *To achieve high boiler efficiency, return temperatures from radiator circuits should be selected lower than 50°C.* • *Where instantaneous plate heat exchangers are used to produce hot water in individual dwellings the return temperature selected should be less than 40°C.* • *Where hot water cylinders are used the coil size should be such as to require a flow rate that results in a nominal return temperature of less than 40°C whilst meeting the required heat-up time.* • *Where hot water is produced centrally (e.g. in each block of dwellings) return temperatures lower than 40°C should be achieved.*
2.0 Controlling the sequencing and firing of boilers	a. Controls for boilers should meet the requirements of the *Non-domestic building services compliance guide*, except optimum start is not required.	*Setting occupation times is not generally possible for a group of dwellings and so optimum start controls are not a requirement.*

Table 24: Recommended minimum standards for the design of new community heating systems to maximise efficiency of heat generation and minimise energy use by pumps *(continued)*		
Community heating	**New systems**	**Supplementary information**
3.0 Minimising energy use by pumps	a. For new community heating systems, the design temperature difference for the community heating primary circuit should be greater than 20°C. b. Variable volume control systems should be used to reduce the volume of water and the pressure difference required from the pumps under part load.	*Pumping energy can be minimised by optimising operating temperatures and pipe sizes to reduce installed pump power.* *To take full advantage of variable volume systems, variable speed pumps should be installed and controlled to deliver the required pressure difference to suit the load.* *Further guidance is provided in BSRIA Application Guide AG 16/2002 "Variable-flow water systems: design, installation and commissioning guidance".*

Table 25: Recommended minimum standards for design of low-carbon heat sources where these are included in community heating systems		
Community heating	**New systems**	**Supplementary information**
1.0 Low carbon heat sources	a. No minimum standard, but see Supplementary Information.	*Community heating systems can be designed to use low-carbon heat sources to meet all or part of the heat demand, which may enable some relaxation of the U-values that would otherwise be required.*

Table 25: Recommended minimum standards for design of low-carbon heat sources where these are included in community heating systems *(continued)*		
Community heating	**New systems**	**Supplementary information**
2.0 Biofuels	a. No minimum standard, but see supplementary information.	*Biofuels can be used to provide heat from boiler systems or as a fuel for CHP systems.* *Consideration should be given to operation and maintenance of the plant to ensure a long life and to prevent a later replacement by a conventional fuel system.* *Where a biofuel boiler is to be used in conjunction with conventionally fuelled heating boilers or electric heating, a reasonable minimum proportion of the annual heat supply from biofuels would be 45% of the annual heat demand (space, domestic hot water and process heating).* *Further guidance is provided in "Low or zero carbon energy sources: strategic guide", ODPM 2006.*
3.0 Combined heat and power (CHP)	a. Where CHP is used in conjunction with boiler plant, the control system should ensure that, as far as is practicable, the CHP plant operates as the lead heat source.	*CHP capacity should be optimised to meet the required economic and environmental objectives.* *A reasonable minimum proportion of the annual heat supply from CHP would be 45% of the annual heat demand (space, domestic and hot water heating).* *To maximise the use of CHP heat over the year, consideration should be given to the use of thermal storage to meet peaks, especially in the early morning period.* *The procedure given in SAP 2009 should be used to calculate the carbon emissions from CHP systems.*

Table 25: Recommended minimum standards for design of low-carbon heat sources where these are included in community heating systems *(continued)*		
Community heating	**New systems**	**Supplementary information**
4.0 Heat Pumps	a. No minimum standard, but see Supplementary Information.	*Heat pumps can be used as a heat source for community heating systems. Selection of operating temperatures to optimise the efficiency of the community heating system and achieve high COPs is important if carbon emissions are to be reduced. This may involve the use of underfloor heating and the provision of domestic hot water by other means.* *Where heat pumps are installed in conjunction with heating boilers, a reasonable minimum proportion of the annual heat supply from the heat pump would be 45% of the annual space heating demand.*
5.0 Solar	a. No minimum standard, but see Supplementary Information.	*Solar thermal panels can be used as the heat source for a centralised domestic hot water system.*

Table 26: Recommended minimum standards for control of systems within dwellings for community heating		
Community heating	**New systems**	**Supplementary information**
1.0 Zoning	a. Dwellings with a total usable floor area up to 150 m^2 should be divided into at least two zones with independent temperature control, one of which is assigned to the living area. b. Dwellings with a total usable floor area greater than 150 m^2 should be provided with at least two space heating zones, each having separate timing and temperature controls.	*In single-storey open-plan dwellings in which the living area is greater than 70% of the total floor area, sub-zoning of temperature control is not appropriate.*

Table 26: Recommended minimum standards for control of systems within dwellings for community heating *(continued)*

Community heating	New systems	Supplementary information
2.0 Time control of space heating	a. Time control of space heating should be provided by: i. a full programmer; ii. two or more separate timers providing timing control to each zone; or iii. programmable room thermostat(s) to the heating circuit(s). b. For dwellings with a total usable floor area greater than 150 m^2, time control for the separate space heating zones can be achieved by: i. multiple heating zone programmers; or ii. a single multi-channel programmer.	*Where the hot water is produced instantaneously, such as with a plate heat exchanger, time control is only required for space heating zones.* *Time control of domestic hot water heating using a cylinder is not considered essential for community heating and could be a disadvantage with CHP-based systems, increasing the morning peak demand and hence causing more use of the boiler than necessary.*
3.0 Temperature control of space heating	a. Separate temperature control of zones within the dwelling should be provided using: i. room thermostats or programmable room thermostats in all zones; ii. a room thermostat or programmable room thermostat in the main zone, and individual radiator controls such as thermostatic radiator valves (TRVs) on all radiators in the other zones; or iii. a combination of (i) and (ii) above.	*Control valves and TRVs should be two-port type to reduce flow rates under part load.* *Differential pressures across control valves and TRVs should be limited to ensure that the control valves work effectively and maintain shut-off.*

Table 26: Recommended minimum standards for control of systems within dwellings for community heating *(continued)*		
Community heating	**New systems**	**Supplementary information**
4.0 Temperature control of domestic hot water	a. Temperature control of the domestic hot water service should be provided by means of two-port control valves either electrically operated or direct-acting.	*Where instantaneous heat exchangers are used the control valve should be selected to maintain steady temperatures (<+/- 5°C) for a range of draw-off rates and primary differential pressures. To reduce the incidence of scaling, the control valve should shut off the primary flow when there is no domestic hot water draw off.* *A small intermittent flow is an advantage to maintain the temperature within the heat exchanger so as to provide more rapid heat up.*
5.0 Limitation of maximum flow rate into building or dwelling	a. The maximum design flow rate into the dwelling heating system should be limited by suitable control and balancing valves to maintain the overall balance in the network and to avoid excessive pumping energy.	

Table 27: Recommended minimum standards for domestic hot water production, storage and water treatment, heat meters and commissioning for community heating		
Community heating	**New systems**	**Supplementary information**
1.0 DHW production and storage	a. The hot water system should be controlled using variable volume control principles and be designed to maintain low return temperatures in the primary community heating circuit.	*Hot water can be produced in four ways in community heating systems:* • *in individual dwellings using indirect storage cylinders;* • *in individual dwellings using instantaneous plate heat exchangers;* • *centrally using storage calorifiers with either an indirect coil or an external plate heat exchanger;* • *centrally using an instantaneous plate heat exchanger.* • *In selecting the system, consideration should be given to:* • *the impact on return temperatures in the community heating system;* • *the impact on flow rates in the community heating system;* • *the impact on heat demand profiles and compatibility with the heat source;* • *standing losses from storage cylinders/calorifiers and the impact on energy use;* • *the quality of service provided in terms of flow rate and temperature control;* • *the advantages of having local storage in terms of security of supply.* *Where the network is extensive and hot water production is centralised, a two stage water heating system can be used to deliver low return temperatures. In this design the return water from the space heating circuit is used to pre-heat the cold feed to the domestic hot water.*

Table 27: Recommended minimum standards for domestic hot water production, storage and water treatment, heat meters and commissioning for community heating		
Community heating	**New systems**	**Supplementary information**
2.0 Water treatment	a. A suitable system for introduction of water treatment chemicals into the community heating system in a controlled manner with facility for monitoring of water quality should be provided.	*A suitable long-term programme of water treatment is essential to preserve the life of the community heating system by limiting internal corrosion. Additional chemical and physical treatment should be evaluated especially for larger systems, including:* • *removal of oxygen by physical means;* • *softened water supply;* • *side-stream filtration;* • *biocide.*
3.0 Heat meters	a. Provision should be made in the design for including heat meters either at the time of installation or at a later date without major pipework changes.	
4.0 Commissioning	a. The community heating system should be commissioned so that the design volume flow rates are supplied to each dwelling and there is no excessive bypassing of water that would lead to higher pumping energy use. b. The flow rates in individual heat emitters should be balanced using appropriate return temperatures or by using calibrated control valves. c. The systems within the dwellings should be demonstrated to the resident and suitable information provided on the operation of the controls	*Where the central heat source includes a low-carbon heat source, the control system should be proven by demonstrating that the low-carbon heat source will normally act as the lead heat source.*

Table 28: Recommended minimum standards for insulation of internal and external pipework for community heating systems

Standards for internal pipework in new systems	**Supplementary information**	
a. Pipes should be insulated to comply with the maximum permissible heat loss indicated in the Supplementary Information column, and labelled accordingly, as follows: i. Primary circulation pipes for heating and hot water circuits should be insulated wherever they pass outside the heated living space or through voids which communicate with and are ventilated from unheated spaces. ii. Primary circulation pipes for domestic hot water circuits should be insulated throughout their length, subject only to practical constraints imposed by the need to penetrate joists and other structural elements. iii. All pipes connected to hot water storage vessels, including the vent pipe, should be insulated for at least 1 metre from their points of connection to the cylinder (or they should be insulated up to the point where they become concealed). iv. If secondary circulation is used, all pipes kept hot by that circulation should be insulated.	***Insulation of pipework in unheated areas*** *Extra provision may need to be made to protect central-heating and hot water pipework in unheated areas against freezing. Guidance is available in:* • *BS 5422:2009 "Method for specifying thermal insulating materials for pipes, tanks, vessels, ductwork and equipment operating within the temperature range -40°C to +700°C".* • *BRE Report No 262 "Thermal insulation: avoiding risks", 2002 Edition.*	
	Where insulation is labelled as complying with this guide, it must not exceed the following heat loss levels:	
	Pipe outside diameter	***Maximum heat loss****
Standards for internal pipework in replacement systems	*8 mm*	*7.06 W/m*
a. Whenever a boiler or hot water storage vessel is replaced in an existing system, any pipes that are exposed as part of the work or are otherwise accessible should be insulated as recommended above – or to some lesser standard where practical constraints dictate.	*10 mm*	*7.23 W/m*
	12 mm	*7.35 W/m*
	15 mm	*7.89 W/m*
	22 mm	*9.12 W/m*
	28 mm	*10.07 W/m*
	35 mm	*11.08 W/m*
	42 mm	*12.19 W/m*
	54 mm	*14.12 W/m*
	**In assessing the thickness of insulation required, standardised conditions should be assumed in all compliance calculations, based on a horizontal pipe at 60°C in still air at 15°C. Further guidance on converting heat loss limits to insulation thickness for specific thermal conductivities is available in TIMSA "HVAC Guidance for achieving compliance with Part L of the Building Regulations".*	

Table 28: Recommended minimum standards for insulation of internal and external pipework for community heating systems *(continued)*

Standards for insulation of external distribution pipework	Supplementary information
a. Community heating pipework should be insulated to the standards defined in EN 253 for pre-insulated pipes or to an equivalent performance for conventionally insulated pipes.	*Community heating pipework typically uses pre-insulated buried pipe systems. Minimum insulation thicknesses are defined in European standards. Where pipework is run above ground the pipe insulation performance should be at least as high as that used in the buried part of the system. Enhanced insulation standards should be evaluated where community heating is supplied only from fossil-fuelled boilers or where flow temperatures over 100°C are being used.* ***Designing for minimum heat losses*** *Heat losses can be reduced by optimising operating temperatures in conjunction with the need to minimise pumping energy. Variable volume control systems will assist in maintaining low return temperatures. Whilst some bypasses may be needed to maintain the system in a hot condition ready to meet the demand these should be controlled to the minimum flow needed. The use of temperature-controlled bypass valves where the bypass only operates when flow temperature has dropped below a set level is recommended.*

Further guidance and standards

Good Practice Guide GPG234 "Guide to community heating and CHP – Commercial, public and domestic applications". Available from the Carbon Trust.
BS EN 13941:2003 "Design and installation of pre-insulated bonded pipe systems for direct heating".
BS EN 14419:2003 "District heating pipes. Pre-insulated bonded pipe systems for directly buried hot water networks. Surveillance systems".
BS EN 253:2003 "District heating pipes. Pre-insulated bonded pipe systems for directly buried hot water networks. Pipe assembly of steel service pipe, polyurethane thermal insulation and outer casing of polyethylene".
BS EN 448:2003 "District heating pipes. Pre-insulated bonded pipe systems for directly buried hot water networks. Fitting assemblies of steel service pipes, polyurethane thermal insulation and outer casing of polyethylene".
BS EN 488:2003 "District heating pipes. Pre-insulated bonded pipe systems for directly buried hot water networks. Steel valve assembly for steel service pipes, polyurethane thermal insulation and outer casing of polyethylene".
BS EN 489:2003 "District heating pipes. Pre-insulated bonded pipe systems for directly buried hot water networks. Joint assembly for steel service pipes, polyurethane thermal insulation and outer casing of polyethylene".

Section 7

Underfloor heating systems

7.1 Scope of guidance

This section provides guidance on the specification of underfloor heating systems in new dwellings to meet relevant energy efficiency requirements in building regulations.

The guidance covers systems that use both hot water pipes and electric heating elements as the underfloor heat source.

7.2 Underfloor heating in new dwellings

Underfloor heating in new dwellings should meet the minimum standards for:

a. system control and safe operating temperatures in Table 29

b. floor insulation and system design to minimise distribution losses in Table 30; and

c. in the case of electric underfloor heating systems in new dwellings, construction and controls in Table 31.

Table 29: Recommended minimum standards for control of wet and electric underfloor heating systems		
Underfloor heating	**New systems**	**Supplementary information**
1.0 System temperature controls: Wet and electric underfloor heating systems	a. All underfloor heating systems, whether warm water or electrical types, should be fitted with controls to ensure safe system operating temperatures: i. A separate flow temperature high-limit thermostat is required for warm water systems connected to any high water temperature heat supply (i.e. operating at more than 60°C). ii. Mixed systems containing both radiators and floor heating, connected to a common high water temperature supply (i.e. operating at more than 60°C), should be provided with a separate means of reducing the water temperature to the floor heating system.	
2.0 Room temperature control: Wet and electric underfloor heating systems	a. Each room should have its own temperature control device; however, it may be acceptable for adjacent rooms with similar function – e.g. kitchens and utility rooms – to share a thermostat or sensor. b. Bathrooms or en-suites which share a heating circuit with an adjacent bedroom will provide heat only when the bedroom thermostat is activated. In such cases, the bathroom or en-suite areas should be fitted with an independent towel rail or radiator. c. Weather compensating controllers should be installed.	

Table 29: Recommended minimum standards for control of wet and electric underfloor heating systems *(continued)*		
Underfloor heating	**New systems**	**Supplementary information**
3.0 Time control: Wet and electric underfloor heating systems	a. Dwellings with a total usable floor area up to 150 m^2 should be divided into at least two zones with independent temperature control, one of which is assigned to the living area. b. Dwellings with a total usable floor area greater than 150 m^2 should be provided with at least two space heating zones each having separate on/off timing controls and temperature controls. c. For single storey open-plan dwellings in which the living area is greater than 70% of the total floor area, sub-zoning of temperature control is not appropriate. d. Thick screed floor heating systems (>65 mm) should have facilities for automatic setback of room temperature to a lower level at night or during unoccupied periods.	*Facilities for automatic setback of room temperature to a lower level at night or during unoccupied periods are recommended for both electric and warm water systems.*
4.0 Boiler control: Wet underfloor heating systems only	a. Warm-water floor heating system controls should be interlocked with the boiler and stored hot water temperature control to ensure that the boiler does not fire when there is no demand for heat for either space or water heating.	

Table 30: Recommended minimum standards for floor insulation and minimising distribution losses in wet and electric underfloor heating systems		
Underfloor heating	**New systems**	**Supplementary information**
1.0 Exposed ground floors	a. Ground floors on earth, or suspended floors in contact with outside air, should be insulated to limit downward heat loss to not more than 10 W/m^2 resulting from thermal resistance of the applied floor finish. b. When heat output is not known, but the floor finish is specified, the extra amount of system thermal insulation may be calculated using the sum of the thermal resistance of the floor finish and the thermal resistance of the underlying heated layer, all multiplied by a factor of 10. c. Supplementary floor heating system thermal insulation may be supplied independently, or added to the statutory insulation requirement. d. Floor heating systems intended for cyclical operation or installed over unheated rooms should be separated from the structural floor by a layer of thermal insulation of at least 1.25 (m^2.K)/W thermal resistance, and installed below the heated plane.	*The specifier should confirm that insulation levels comply with Approved Document L1A standards.*
2.0 Intermediate floors with heated rooms below: wet systems	a. Intermediate floors with heated rooms below should have a separating layer of system thermal insulation to comply with either 1b above or BS EN1264 Part 4, where the minimum thermal resistance is given as not less than R = 0.75 (m^2.K)/W.	*Thermal insulation of party floors is essential because the floor or ceiling is directly coupled to the heating elements.*
3.0 Intermediate floors with heated rooms below: electric systems	a. Intermediate floors with heated rooms below should either comply with 1.0 b. above or have a separating layer of system thermal insulation where the minimum thermal resistance is not less than R = 0.5 (m^2.K)/W.	

Table 30: Recommended minimum standards for floor insulation and minimising distribution losses in wet and electric underfloor heating systems *(continued)*

Underfloor heating	New systems	Supplementary information
4.0 System design to minimise distribution losses	a. Underfloor heating distribution boards or warm water distribution manifolds should be located centrally between the rooms being heated, thus minimising the length of interconnecting services. b. Service pipes carrying hot water to more distant rooms should be insulated or routed through conduits to reduce distribution losses and the risk of overheating the room or floor finish.	
5.0 System commissioning and corrosion protection **Control of oxidation, biofilm, scale and sludge in warm water heating systems**	a. Commissioning warm water floor heating systems should be carried out in accordance with BS EN 1264 Part 4. Even where plastic tubes contain oxygen gas barriers, the control of corrosion in mixed product heating systems must be addressed carefully. b. After testing and flushing with clean water, the system circulating fluid should be treated with a suitable corrosion inhibitor approved by the tube manufacturer and complying with BS 7593:2006 or DIN 4725/6, and applied strictly in accordance with the additive manufacturer's instructions.	***British Standards*** *BS 7593:2006 "Code of practice for treatment of water in domestic hot water central heating systems".* *Inhibitors should as a minimum be BuildCert approved.* *Note should also be made of advice in the manufacturer's instructions.*

Table 31: Recommended minimum standards for construction and control of electric underfloor heating systems			
Underfloor heating		**New systems**	**Supplementary information**
Electric storage systems with individual room or programmable thermostats and low tariff anticipatory controls	**1.0 Construction**	a. Electric cable underfloor heating low tariff night energy storage systems should have a 65 mm minimum thickness screed for correct operation. b. Principal rooms containing 80% floor area should be assigned to low tariff heating cables and 20% of the floor area should be assigned to either direct-acting perimeter heating cables or systems such as ceiling or panel heaters in order to maximise energy efficiency.	*Other areas should be assigned as low tariff heating cables only (subject to heat requirements). Bathrooms and separate kitchens may have direct-acting heating cables (subject to heat requirements).*
	2.0 Controls	a. Anticipatory controllers should be installed controlling low tariff input charge with external temperature sensing and floor temperature sensing. b. Programmable room thermostats with an override feature should be provided for all direct-acting zones of the system with air and floor temperature sensing capabilities to be used individually or combined.	*Anticipatory controllers (i.e. weather compensators) reduce night energy storage as a function of external temperature.*
Electric cable, direct-acting (non-storage) systems with individual room timer or thermostat control in screeded floors	**3.0 Construction**	a. Direct-acting electric underfloor heating cables should be installed within screeds of thickness not exceeding 60 mm. b. All heated floors should be insulated in accordance with Table 30.	
	4.0 Controls	a. Programmable room thermostats with a manual override feature for all heating zones with air or floor temperature sensing capabilities should be used individually or combined.	

Table 31: Recommended minimum standards for construction and control of electric underfloor heating systems *(continued)*			
Underfloor heating		**New systems**	**Supplementary information**
Electric cable, direct-acting systems with individual room timer or thermostat control in timber floors	**5.0 Construction**	a. Direct-acting electric underfloor heating cables installed below floor boards in voids between floor joists should be insulated in accordance with Table 30.	
	6.0 Controls	a. Programmable room thermostats with a manual override feature should be provided to control space temperature and limit floor void temperature for safety and comfort in each area.	
Under-tile electric floor heating systems	**7.0 Construction**	a. Direct-acting electric underfloor heating cables should be provided with a pre-fabricated mattress, or equivalent IEC 60800 approved heating cable product, of thickness less than 4 mm encapsulated in tile bedding adhesive or mortar, below a ceramic or other equivalent floor finish on a thermally resistive insulation layer as defined in Table 30(1.0 b.).	
	8.0 Controls	a. Programmable room thermostats with a manual override feature should be provided to control space temperature and limit floor temperature for safety and comfort in each area.	

Section 8

Mechanical ventilation systems

8.1 Scope of guidance

This section provides guidance on the specification of mechanical ventilation systems in dwellings to meet relevant energy efficiency requirements in building regulations.

The guidance covers the following types of mechanical ventilation:

- intermittent mechanical extract ventilation
- continuous mechanical extract ventilation
- continuous mechanical supply ventilation
- continuous mechanical supply and extract with heat recovery.

8.2 Energy efficiency of mechanical ventilation systems

Mechanical ventilation systems should:

a. follow the guidance in:

   i. GPG 268 *Energy efficient ventilation in dwellings – a guide for specifiers*; and

   ii. the CLG publication *Domestic ventilation compliance guide* (available from www.planningportal.gov.uk/approveddocuments > *Part L* > *Associated documents*); and

b. meet the minimum standards for specific fan power, heat recovery efficiency and controls in Table 32.

Table 32: Recommended minimum standards for mechanical ventilation systems		
	New and replacement systems	**Supplementary information**
1.0 Fan power	a. Mechanical ventilation systems should be designed to minimise electric fan power. Specific fan power (SFP) should not be worse than: i. 0.5 W/(l/s) for intermittent extract ventilation systems; ii. 0.7 W/(l/s) for continuous extract ventilation systems; iii. 0.5 W/(l/s) for continuous supply ventilation systems; iv. 1.5 W/(l/s) for continuous supply and extract with heat recovery ventilation systems.	
2.0 Heat recovery efficiency	a. The heat recovery efficiency of balanced mechanical ventilation systems incorporating heat recovery should not be worse than 70%.	
3.0 Controls	a. Intermittent mechanical extract ventilation systems should be operated by local manual switches or automatically by a presence sensor. b. All other mechanical ventilation systems should have manual or automatic control of the boost facility.	***British Standards*** *BS EN 15232:2007 "Energy performance of buildings – Impact of building automation, controls and building management".*

Section 9

Heat pump systems

9.1 Scope of guidance

This section provides guidance on the specification of heat pump systems in dwellings for the provision of space heating and domestic hot water to meet relevant energy efficiency requirements in building regulations.

A heat pump is a device which takes heat energy from a low temperature source and upgrades it to a higher temperature at which it can be usefully employed for heating or hot water. Heat pumps may supply all or part of the heating load.

The guidance in this section applies to the types of electrically-driven heat pump in Table 33.

Table 33: Heat pump technologies

Heat pump type	Warm water and hot water systems	Warm air systems
Ground source systems (GSHP) *Heat energy is extracted from the ground using closed pipe loops buried horizontally in trenches or in vertical boreholes that are connected back to the GSHP. The fluid circulating in the closed loop is normally a water/propylene glycol antifreeze mixture or accepted equivalent but some direct expansion GSHPs use refrigerant. Open loops may also be used to collect water from an aquifer and discharge via a separate aquifer downstream of the water table flow; systems of this type normally require permits from the Environment Agency. Heat extracted from the ground may be supplied to a dwelling either by a water-based heating system (ground-to-water heat pump) or by an air distribution system (ground-to-air heat pump).*	*Ground-to-water*	*Ground-to-air*

Table 33: Heat pump technologies *(continued)*		
Heat pump type	**Warm water and hot water systems**	**Warm air systems**
Water source systems (WSHP) *Heat energy is extracted indirectly from a water source using closed pipe loops as a heat exchanger. The closed loop is connected back to the water to water heat pump. The water source may be a lake, pond or river or other stable water source. The fluid circulating in the closed loop will normally be water but a water/propylene glycol or accepted equivalent antifreeze mixture may be used, depending on operating temperatures. Open loops may also be used subject to the permits being obtained from the Environment Agency. Heat may be supplied to the dwelling either by a water-based heating system (water-to-water heat pump) or by an air distribution system (water-to-air heat pump).*	*Water-to-water*	*Water-to-air*
Air source systems (ASHP) *Air source heat pumps extract heat directly from the ambient air. Heat is supplied to the dwelling either by a water-based heating system (air-to-water heat pump) or by an air distribution system (air-to-air heat pump). Air-to-air heat pumps may be single package or split systems.*	*Air-to-water*	*Air-to-air*
All heat pump systems are at their most efficient when the source temperature is as high as possible, the heat distribution temperature is as low as possible and pressure losses in air and water systems are kept to a minimum. If installed in a new dwelling, heat pumps should use refrigerants complying with the provisions of EU Directive 2037:2000. Heat pumps should be CE marked in accordance with applicable EU Directives: e.g. the machinery safety, low voltage, pressure equipment and electromagnetic compatibility directives. If summer cooling is provided by the heat pump, it is recommended that condensate drainage from the indoor units is provided.		

9.2 Key terms

Coefficient of performance (CoP) is a measure of the efficiency of heat pumps.

Heating CoP = heat output/power input.

% CoP (***CoP*** x 100) is the ***heat generator*** efficiency.

Seasonal performance factor (SPF) is the operating performance of an electric heat pump over the season. It is the ratio of the heat delivered and the total energy supplied over the season.

9.3 Warm water and hot water heat pumps

Electrically-driven heat pumps used as the heat generator in, e.g. underfloor, warm air and medium temperature radiator heating systems should:

a. have a ***coefficient of performance*** not less than 2.2[8] when used for space heating

b. have a ***coefficient of performance*** not less than 2.0 when used for heating domestic hot water

c. have a ***seasonal performance factor*** not worse than the minimum required by BS EN 15450 Table C1 for new build and Table C2 for existing build

d. meet the minimum standards for supply temperature, wet system radiator efficiency, installation and commissioning, hot water and controls in Table 34 for warm water and hot water heat pumps

e. meet the minimum standards for installation and controls in Table 35 for warm air heat pumps.

[8] CoP to be measured according to procedures in BS EN 14511-4:2007.

Table 34: Recommended minimum standards for warm water and hot water heat pumps (ground-to-water, water-to-water and air-to-water systems)		
Warm and hot water heat pumps	**New and replacement systems**	**Supplementary information**
1.0 Supply water temperatures and efficiency	**Underfloor heating** a. Supply water temperatures to the underfloor heating system should be in the range 30°C to 40°C for new buildings and 30°C to 55°C for existing systems.	*Section 7 of this guide on underfloor heating.*
	Radiators a. High-efficiency radiators with high water volume should be utilised. b. Supply water temperature to the radiators should be in the range 40°C to 55°C.	*Space heating may be sized to meet all or part of the space heating load. Secondary heating will be required if the heat pump is sized to meet part of the space heating load.*
	Fan coil units a. Supply water temperature to the fan coil units should be in the range 35°C to 45°C.	*Fan coil units may be utilised for heating only or for winter heating and summer cooling.*

Table 34: Recommended minimum standards for warm water and hot water heat pumps (ground-to-water, water-to-water and air-to-water systems) *(continued)*		
Warm and hot water heat pumps	**New and replacement systems**	**Supplementary information**
2.0 Installation and commiss-ioning	a. The water distribution system should be arranged for reverse return operation or arranged with a low loss manifold system to maximise efficiency and ease commissioning and future maintenance. b. Pipework not contributing to the space heating should be insulated to prevent heat loss following the guidance in the TIMSA guide. c. If summer cooling is provided by the heat pump, all water distribution pipework should be insulated to prevent condensation following the guidance in the TIMSA guide. d. External pipework between the dwelling and the ground heat exchanger should be insulated following the TIMSA guidance. e. The ground loop water circuit should be protected with an anti freeze solution and inhibitor as recommended by the heat pump manufacturer. f. Ground loops should be cleaned with a cleaning fluid and biocide as part of the commissioning process.	***Design*** *A pressurised water distribution system with expansion vessel is recommended.* *Constant water flow should be maintained through the heat pump.* *Pipe sizes should be in accordance with the manufacturer's recommendations.* ***Installation*** *Installation should be carried out by an installer approved by the manufacturer.* *If during installation access to the refrigeration circuit is needed, a competent refrigeration and air conditioning engineer (with a valid refrigerant handling certificate or an Engineering Services Skillcard) should carry out the work.* *Exposed refrigeration pipework should be insulated and enclosed in protective trunking to limit accidental damage.* *Installation of the dwelling's water distribution system should be undertaken by a competent central heating specialist.*

Table 34: Recommended minimum standards for warm water and hot water heat pumps (ground-to-water, water-to-water and air-to-water systems) *(continued)*		
Warm and hot water heat pumps	**New and replacement systems**	**Supplementary information**
2.0 Installation and commiss-ioning *(continued)*	g. The internal water distribution circuit should contain an inhibitor and may be protected by an anti freeze solution as recommended by the heat pump manufacturer. h. Ground loops should be filled with a heat transfer fluid. Installers should also refer to the equipment manufacturer's installation instructions for appropriate treatment products and special requirements for individual appliance models.	***Guidance and standards*** *TIMSA "HVAC guidance for achieving compliance with Part L of the Building Regulations".* *BS EN 378 "Specification for refrigerating systems and heat pumps".* *TR30 "Guide to good practice – heat pumps", HVCA July 2007.* *MIS 3005 "Requirements for contractors undertaking the supply, design, installation, set to work, commissioning and handover of microgeneration heat pump systems", BERR 2008.*
3.0 Domestic hot water	a. For full heating, the heat pump and any supplementary domestic hot water heating should be capable of supplying water in the range 60°C to 65°C. This is applicable to ground-to-water, water-to-water and air-to-water type heat pumps. b. If the heat pump is not capable of supplying water at these temperatures, supplementary heating should be provided and controlled as described in other sections of this guide. Controls should include an auxiliary heating regime to 60°C or more for disinfection purposes. c. The domestic hot water (DHW) system should include a tank thermostat and a time clock to optimise the time taken to heat the water.	*The heat pump may be utilised for all or part of the DHW load. During the DHW heating period the heat pump may not necessarily be providing heated water to the space heating system.*

Table 34: Recommended minimum standards for warm water and hot water heat pumps (ground-to-water, water-to-water and air-to-water systems) *(continued)*		
Warm and hot water heat pumps	**New and replacement systems**	**Supplementary information**
4.0 Controls	a. Heat pump unit controls should include: i. control of water pump operation (internal and external as appropriate); ii. control of water temperature for the distribution system; iii. control of outdoor fan operation for air-to-water units; iv. defrost control of external airside heat exchanger for air-to-water systems; v. protection for water flow failure; vi. protection for high water temperature; vii. protection for high refrigerant pressure; viii. protection for air flow failure on air-to-water units. b. External controls should include: i. room thermostat to regulate the space temperature and interlocked with the heat pump unit operation; ii. timer to optimise operation of the heat pump.	

Table 35: Recommended minimum standards for warm air heat pumps (ground-to-air, water-to-air and air-to-air systems)		
Warm air heat pumps	**New and replacement systems**	**Supplementary information**
1.0 Installation	a. Minimum clearances adjacent to all airflow paths, as recommended by the manufacturer, should be maintained. b. Pipe sizes should be in accordance with the manufacturer's recommendations. c. The refrigerant pipework on split systems should be insulated in line with the manufacturer's recommendations. d. If summer cooling is provided by the heat pump, provision should be made for condensate drainage from the indoor terminal units. e. For ground-to-air and water-to-air systems all external pipework between the dwelling and the external heat exchanger should be insulated by following TIMSA guidance. f. For ground-to-air and water-to-air systems constant water flow should be maintained through the heat pump.	*Installation should be carried out by an installer approved by the manufacturer.* *Installation that requires access to the refrigeration circuit, or the connection of split systems, should be carried out by a competent refrigeration and air conditioning engineer holding a refrigerant handling certificate and, preferably, an Engineering Services Skillcard.* *TIMSA "HVAC guidance for achieving compliance with Part L of the Building Regulations".*

Table 35: Recommended minimum standards for warm air heat pumps (ground-to-air, water-to-air and air-to-air systems) *(continued)*		
Warm air heat pumps	**New and replacement systems**	**Supplementary information**
2.0 Controls	a. Heat pump unit controls should include: i. control of room air temperature (if not provided externally); ii. control of outdoor fan operation for air-to-air units; iii. defrost control of external airside heat exchanger for air-to-air systems; iv. control for secondary heating (if fitted) on air-to-air systems; v. control of external water pump operation for ground-to-air and water-to-air systems; vi. protection for high water temperature; vii. protection for high refrigerant pressure; viii. protection for indoor air flow failure; ix. protection for external air flow failure on air-to-air units; x. protection for water flow failure on ground-to-air and water-to-air systems.	

Table 35: Recommended minimum standards for warm air heat pumps (ground-to-air, water-to-air and air-to-air systems)		
Warm air heat pumps	**New and replacement systems**	**Supplementary information**
2.0 Controls *(continued)*	b. External controls should include: i. room thermostat (if not provided internal to the heat pump) to regulate the space temperature, and interlocked with the heat pump unit operation; ii. timer to optimise operation of the heat pump.	

Supplementary information – further guidance on heat pumps

EU Directives for machinery safety, low voltage, pressure equipment, electromagnetic compatibility.

SAP 2009.

Defra/Carbon Trust Energy Technology List – Heat Pumps.

BS EN 14511 "Air conditioning, liquid chilling packages and heat pumps with electrical driven compressors for space heating and cooling". Parts 1-4.

BS EN 15450 "Heating systems in buildings. Design of heat pump heating systems".

BS EN 15316 "Heating systems in buildings. Method for calculation of system energy requirements and system efficiencies". Part 4.2: "Space heating generation systems, heat pump systems".

ISO 13256 "Water-source heat pumps – testing and rating for performance": Part 1 – "Water-to-air and brine-to-air heat pumps" and Part 2 – "Water-to-water and brine-to-water heat pumps".

CE 82 Energy Efficiency Best Practice in Housing: "Domestic ground source heat pumps: design and installation of closed-loop systems".
BS EN 378 "Specification for refrigerating systems and heat pumps. Safety and environmental requirements and system efficiencies". Part 4-2: "Space heating generation systems, heat pump systems".

Microgeneration Certification Scheme MIS 3007 "Product certification scheme requirements – heat pumps".

Microgeneration Certification Scheme MIS 3005 "Requirements for contractors undertaking the supply, design, installation, set to work, commissioning and handover of microgeneration heat pump systems", BERR 2008.

EU Ecolabel "Establishing the ecological criteria for the award of the Community eco-label to electrically-driven, gas-driven or gas absorption heat pumps".

Heat Pump Association data sheet "Air-to-water heat pumps".

HVCA TR30 "Guide to good practice: Heat pumps".

Section 10

Comfort cooling systems

10.1 Scope of guidance

This section provides guidance on the specification of fixed mechanical comfort cooling systems in dwellings to meet relevant energy efficiency requirements in building regulations.

(Dwellings should always be designed to avoid or minimise the need for cooling through the appropriate use of solar control, secure ventilation and thermal mass.)

10.2 Air-cooled and water-cooled air conditioners

Cooling systems in new and existing dwellings should:

a. meet the minimum standards for efficiency in Table 36; and

b. be controlled to prevent simultaneous heating and cooling of the same space within the dwelling.

Table 36: Recommended minimum standards for comfort cooling		
Comfort cooling	**New and replacement systems**	**Supplementary information**
1.0 Efficiency	a. Air-cooled air conditioners working in cooling mode should have an EER greater than 2.4. b. Water-cooled air conditioners working in cooling mode should have an EER greater than 2.5. c. Fixed air conditioners should have an energy efficiency classification equal to or better than Class C in Schedule 3 of the labelling scheme adopted under The Energy Information (Household Air Conditioners) (No. 2) Regulations, SI 2005/1726.	*Installation should be carried out by an installer approved by the manufacturer or supplier. The installer should be a competent refrigeration and air conditioning engineer with a valid refrigerant handling certificate.* *Exposed refrigeration pipework should be insulated and enclosed in protective trunking to limit accidental damage.* *www.eurovent-certification.com*
Supplementary information ***British Standards*** *BS EN 14511-2 "Air conditioners, liquid chilling packages and heat pumps with electrically driven compressors for space heating and cooling – Test conditions".* *BS EN 14511-4 "Air conditioners, liquid chilling packages and heat pumps with electrically driven compressors for space heating and cooling – Requirements".*		

Section 11

Solar water heating

11.1 Scope of guidance

This section provides guidance on the specification of solar water heating for dwellings to meet relevant energy efficiency requirements in building regulations.

The guidance in this section covers indirect solar systems with a collector area of less than 20 m^2 and solar heated water storage of less than 440 litres. It does not cover "direct" solar systems[9] or systems intended to contribute exclusively to space heating or systems providing heat exclusively to heat swimming pools. It should be used in conjunction with the guidance on water heating contained in the fuel-based sections of this guide.

11.2 Indirect systems

Indirect solar heating systems installed as new systems and replacement systems should meet the minimum standards for:

a. collector certification, identification and testing, collector primary loop transfer fluid, circulation pump power, heat-exchanger sizing, system control, solar pre-heated water storage, and system preparation in Table 37

b. system labelling and commissioning in Table 38

c. insulating pipes in a solar primary system in Table 39.

Supplementary information

When work is carried out on an existing indirect solar hot water system, it is recommended that the system controls and insulation should be upgraded in line with the standards for new and replacement systems.

[9] The Microgeneration Certification Scheme Standard MIS3001 Issue 1.7, January 2010, gives guidance on solar heating systems with a dedicated solar volume that is below the minimum recommended for indirect systems. SAP 2009 Appendix H sets out rules for estimating the annual energy performance of solar heating systems, including direct systems.

Table 37: Recommended minimum standards for indirect solar water heating		
Solar water heating	**New and replacement systems**	**Supplementary information**
1.0 Allowance for collector shading	a. No minimum provision.	*Solar collectors should be sited in unshaded locations wherever possible. Where this is unavoidable or in cases of significant or heavy shading or significant variance to the optimum orientation and tilt (i.e. normal pitch roofs facing between SE and SW), then an allowance for the loss of performance should be made when sizing the collector area according to the factors indicated in SAP 2009 Appendix H.*
2.0 Solar collector certification	a. Collectors should be independently certified to comply with all required tests for safety and thermal performance, and for reporting and identification according to BS EN 12975.	*Copies of the full test report should be made available upon request.*
3.0 Primary circuit fluid	a. The transfer fluid in the collector primary loop should be chosen so as not to deposit limescale, sludge, ice or other solids that could either restrict circulation or impair the rate of heat transfer within the absorber.	*In secondary systems, measures to reduce the formation of limescale should be considered so that performance is not significantly affected.*
4.0 Circulation pump power	a. The electrical input power of the primary pump in the solar system should be less than 50 W or 2% of peak thermal power of collector, whichever is the higher.	

Table 37: Recommended minimum standards for indirect solar water heating *(continued)*		
Solar water heating	**New and replacement systems**	**Supplementary information**
5.0 Heat-exchanger sizing	a. The heat exchanger between a solar primary and secondary system should be sized so that not less than 0.1 m^2 or equivalent of heat exchanger area is provided per 1 m^2 of solar collector net absorber area.	*A heat exchanger reduces the possibility of clogging and deposition due to dirt, scale or similar impurities that could reduce the system performance.* *Heat exchangers and store connections should be sized and located to promote a low return temperature to the solar collector. Solar heat exchangers are often sized larger than those usually used on gas- or oil-based primary systems owing to the lower temperature of transfer.*

Table 37: Recommended minimum standards for indirect solar water heating *(continued)*		
Solar water heating	**New and replacement systems**	**Supplementary information**
6.0 System control	a. Solar domestic hot water (DHW) system controls should be fitted to: i. maximise the useful energy gain from the solar collectors into the system's dedicated storage; ii. minimise the accidental loss of stored energy by the solar DHW system, whether originating from solar collectors, cold intake or auxiliary heat sources; iii. ensure that hot water produced by back-up (auxiliary) heat sources is not used when adequate grade solar pre-heated water is available; iv. provide a means of control consistent with the solar system being hydraulically (inherently) secure against the adverse affects of excessive primary temperatures and pressures; v. where a separate DHW heating appliance is pre-heated by a solar system, control the appliance where possible such that no extra heat is added if the target temperature is already satisfied from the pre-heat vessel; vi. inform the end user of the system's correct function and performance at all times.	

Table 37: Recommended minimum standards for indirect solar water heating *(continued)*		
Solar water heating	**New and replacement systems**	**Supplementary information**
7.0 Solar pre-heated water storage	a. Vented copper hot water storage vessels should comply with the heat loss and back-up heating heat exchanger requirements of BS 1566-1:2002. b. Unvented hot water storage system products should: i. comply with BS EN 12897; or ii. be certified by the British Board of Agrément, the Water Research Council or other accredited body as complying with building regulations. c. Primary storage systems should meet the insulation requirements of sections 4.3.1 or 4.3.2 of the Hot Water Association *Performance specification for thermal stores*.	*Vented copper hot water cylinders should carry clear labelling on the product such as a BSI Kitemark, registered firm status or reference to an equivalent quality control scheme.* *Vented cylinders which are not of copper construction should be labelled as complying with the heat loss and heat exchanger requirements of BS 1566.* *Due to the higher than normal storage temperatures in primary stores, it is very important that they are well insulated.*
8.0 Volume of solar pre-heated water	a. The ratio of solar heated water storage volume to collector area should be as follows: i. The dedicated solar storage volume, Vs, should be at least 25 litres (or equivalent heat capacity) per net square metre of the solar collector absorber area. ii. Alternatively, Vs should be a volume (or equivalent heat capacity) which is equivalent to at least 80% of the daily hot water demand, Vd (as defined by SAP 2009).	*Collector area is measured as effective aperture or net absorber area, whichever is smaller.* *A separate pre-heat storage vessel should be considered wherever possible.*

Table 37: Recommended minimum standards for indirect solar water heating *(continued)*		
Solar water heating	**New and replacement systems**	**Supplementary information**
9.0 System preparation and water treatment	**New build** a. Solar primary circuits should be thoroughly cleaned with an appropriate cleaner and flushed through with solar heat transfer fluid before filling with the solar heat transfer fluid. b. Systems should be filled with a heat transfer fluid containing a volatile inhibitor package, capable of protecting the system from frost and corrosion at all operating temperatures. c. Installers should refer to the equipment manufacturer's installation instructions for appropriate treatment products and special requirements for individual appliance models. d. Where mains water is used to fill the solar primary circuit and the total water hardness exceeds 200 parts per million, provisions should be made to reduce the limescale. **Existing installations** a. Solar thermal systems should be cleaned with an appropriate cleaner formulated to remove build-up of degradation films from exhausted heat transfer fluids, then flushed through with fresh solar heat transfer fluid. b. Systems should be filled with a heat transfer fluid containing a volatile inhibitor package, capable of protecting the system from frost and corrosion at all operating temperatures. c. Installers should refer to the equipment manufacturer's installation instructions for appropriate treatment products and special requirements for individual appliance models.	*Parts of BS 7593:2006 "Code of practice for treatment of water in domestic hot water central heating systems" may assist in flushing and cleaning procedures.* *"Legionnaire's disease: The control of legionella bacteria in water systems". Approved code of practice and guidance, HSE Books.*

Table 38: Recommended minimum standards for labelling, commissioning and documentation for solar hot water systems		
Solar water heating	**New and replacement systems**	**Supplementary information**
1.0 Labelling of solar collectors and hot water stores	a. All solar collectors should have a visible and durable label displaying all information required according to BS EN 12975, and including at least the following: i. name of manufacturer; ii. collector type; iii. serial number; iv. year of production; v. gross area of collector; vi. aperture area of collector; vii. net absorber area of collector; viii. maximum operation pressure; ix. stagnation temperature at 1000 W/m^2 and 30°C ambient; x. volume of heat transfer fluid; xi. weight of empty solar collector. b. All hot water storage vessels should carry a label with the following information: i. manufacturer's name; ii. nominal overall capacity in litres; iii. dedicated solar capacity in litres; iv. standing heat loss in kWh/day; v. type of vessel; vi. back-up heating heat exchanger performance in kW (where present); vii. solar heating heat exchanger performance in kW.	*In addition to the minimum provision for labelling of hot water storage vessels, labelling with the following information is also recommended:* • *Total net fluid content of secondary volume normally heated by each heat exchanger, where present (+/- 1.0 litre).* • *The type, fluid content, maximum pressure and surface area of all heat exchangers.*

Table 38: Recommended minimum standards for labelling, commissioning and documentation for solar hot water systems *(continued)*		
Solar water heating	**New and replacement systems**	**Supplementary information**
2.0 Commissioning	a. A signed and dated commissioning certificate should be completed to confirm the equipment has been correctly installed and to record key safety and operational features. b. As a minimum, the commissioning certificate should record the following details of the solar system: i. net or aperture area of solar collector; ii. minimum ambient temperature without freeze damage to components; iii. location of device and method for controlling over-pressure; iv. location of the electrical isolating switch; v. type of circulation fluid; vi. circulation rate of collector circuit; vii. location of device for protecting against overheating of solar heated water.	*A signed commissioning certificate, certifying that the equipment is safe, legal and fit for its intended purpose, should be handed over to the dwelling owner or user as applicable.* *A separate certificate is required to cover the installation and commissioning of the hot water storage vessels and appliances within a solar DHW system.* *A commissioning engineer should be a competent person who can personally testify by signature and date that the equipment has been commissioned.*
3.0 Documentation	a. No minimum standard.	*Information concerning the solar DHW system should be provided to the dwelling owner or user as applicable. The documentation should include:* • *user's manual;* • *warranty information;* • *a recommended maintenance schedule;* • *commissioning certificate;* • *full contact details of the installer.*

Table 39: Recommended minimum standards for insulation of pipework in solar hot water systems

New and replacement systems	Supplementary information
a. All pipes of a solar primary system should be insulated throughout the length of the circuit. b. All other pipes connected to hot water storage vessels, including the vent pipe, should be insulated for at least 1 metre from their points of connection to the cylinder, or insulated up to the point where they become concealed. c. Pipes should be insulated with materials labelled as complying with the *Domestic building services compliance guide* and in line with the guidance in the TIMSA guide.	*The insulation should be suitably rated for the maximum foreseeable pipe temperature applicable, and where external also be resistant to vermin attack and climatic degradation.* *In a dwelling that already has a solar hot water system, it is recommended that the insulation should be upgraded in line with these minimum provisions where significant work, such as change of solar storage, is carried out.* *A fully-filled or drainback solar hot water system can have a pipe service temperature of 150°C. Therefore an insulation material should be specified to accommodate this temperature. An EPDM based rubber would normally be a minimum requirement for such an application. Any insulation specified must be better than 0.044 W/m.K at 40°C mean and the insulation diameter must be 87% of the pipe diameter.* *Where insulation is labelled as complying with this guide, it must not exceed the following heat loss values:*

Pipe outside diameter	***Maximum heat loss***
8 mm	*7.06 W/m*
10 mm	*7.23 W/m*
12 mm	*7.35 W/m*
15 mm	*7.89 W/m*
22 mm	*9.12 W/m*
28 mm	*10.07 W/m*
35 mm	*11.08 W/m*
42 mm	*12.19 W/m*
54 mm	*14.12 W/m*

Table 39: Recommended minimum standards for insulation of pipework in solar hot water systems *(continued)*	
New and replacement systems	**Supplementary information**
	Further guidance on converting heat loss limits to thicknesses of insulation for specific thermal conductivities is available in the TIMSA "HVAC guidance for achieving compliance with Part L of the Building Regulations". ***Insulation for pipework in unheated areas*** *Extra provision may need to be made to protect water-carrying pipework in unheated areas against freezing. Further guidance is available in:* • *BS 5422:2009 "Method for specifying thermal insulating materials for pipes, tanks, vessels, ductwork and equipment operating within the temperature range of -40°C to +700°C".* • *BRE Report No 262 "Thermal insulation: avoiding risks", 2002 Edition.*

Supplementary information

Guidance and standards

Microgeneration Certification Scheme MIS3001 "Requirements for contractors undertaking the supply, design, installation, set to work, commissioning and handover of solar heating microgeneration systems", January 2010.
Energy Efficiency Best Practice in Housing CE131 "Solar water heating systems. Guidance for professionals".
CIBSE "Solar heating design and installation guide". ISBN 978-1-903287-84-2.
CE 51/GIL59 "Central Heating System Specifications (CHeSS)", 2005.
BS 7431:1991 "Method for assessing solar water heaters. Elastomeric materials for absorbers, connecting pipes and fittings".
BS 6785:1986 "Code of practice for solar heating systems for swimming pools".
prCEN/TS 12977-3:2006 "Performance characterisation of stores for solar heating systems".
prCEN/TS 12977-2:2005 "Thermal solar systems and components. Custom built systems. Test methods".
TS 12977-1:2001 "Thermal solar systems and components. Custom built systems. General requirements".
BS EN ISO 9488:2000 "Solar energy. Vocabulary".
BS EN 12976-2:2006 "Thermal solar systems and components. Factory made systems. Test methods".
BS EN 12976-1:2006 "Thermal solar systems and components. Factory made systems. General requirements".
BS EN 12975-2:2006 "Thermal solar systems and components. Solar collectors. Test methods".
BS EN 12975-1:2006 "Thermal solar systems and components. Solar collectors. General requirements".
ISO 9553:1997 "Solar energy-Methods of testing preformed rubber seals and sealing compounds used in collectors",
BS 3734-1: 1997 "Rubber – Tolerances for products – Part 1: Dimensional tolerances".
BS 903-0:2003 "Physical testing of rubber – Part 0: General".
BS 6920:2000 "Suitability of non-metallic products for use in contact with water intended for human consumption with regard to their effect on the quality of water".
ISO/TR 10217:1989 "Solar energy water heating systems guide".
to material selection with regard to internal corrosion
BS 8000 "Workmanship on building sites".
BS EN 12897:2006 "Water supply. Specification for indirectly heated unvented (closed) storage water heaters".
BS 7671:2008 "Requirements for electrical installations".
BS 1566 "Copper indirect cylinders for domestic purposes".
BS 4814:1990 "Specifications for expansion vessels using an internal diaphragm for sealed hot water heating systems".
BS 7074 "Application, selection and installation of expansion vessels and ancillary equipment for sealed water systems".
BS 5422:2009 "Methods of specifying thermal insulation materials on pipes, ductwork and equipment in the temperature range of –40°C to 700°C".
BS 5449:1990 "Specification of forced circulation hot water central heating systems for domestic premises".
BS 6701:2010 "Telecommunications equipment and telecommunications cabling".
BS 5970:2001 "Code of practice for thermal insulation of pipes and equipment".
BS 6700:2006 " Specification and design, installation, testing and maintenance of services supplying water for domestic uses within buildings and their curtilages".

Section 12

Lighting

12.1 Scope of guidance

This section provides guidance on the specification of fixed internal and external lighting for new and existing dwellings to meet relevant energy efficiency requirements in building regulations.

12.2 Key terms

Circuit-watt means the power consumed in lighting circuits by lamps and, where applicable, their associated control gear (including transformers and drivers) and power factor correction equipment.

Light fitting means a fixed light or lighting unit that can comprise one or more lamps and lampholders, control gear and an appropriate housing. The control gear may be integrated in the lamp or located elsewhere in or near to the fixed light.

Fixed external lighting means lighting fixed to an external surface of the dwelling supplied from the occupier's electrical system. It excludes lighting in common areas of blocks of flats and in other communal accessways.

12.3 Internal and external lighting

Fixed internal and external lighting should meet the minimum standards for efficacy and controls in Table 40.

Table 40: Recommended minimum standards for fixed internal and external lighting		
Lighting	**New and replacement systems**	**Supplementary information**
Fixed internal lighting	a. In the areas affected by the building work, provide low energy ***light fittings*** (fixed lights or lighting units) that number not less than three per four of all the ***light fittings*** in the main dwelling spaces of those areas (excluding infrequently accessed spaces used for storage, such as cupboards and wardrobes). b. Low energy ***light fittings*** should have lamps with a luminous efficacy greater than 45 lamp lumens per circuit-watt and a total output greater than 400 lamp lumens. c. ***Light fittings*** whose supplied power is less than 5 circuit-watts are excluded from the overall count of the total number of light fittings.	***Light fittings*** *may be either:* • *dedicated fittings which will have separate control gear and will take only low energy lamps (e.g. pin based fluorescent or compact fluorescent lamps); or* • *standard fittings supplied with low energy lamps with integrated control gear (e.g. bayonet or Edison screw base compact fluorescent lamps).* ***Light fittings*** *with GLS tungsten filament lamps or tungsten halogen lamps would not meet the standard.* *The Energy Saving Trust publication GIL 20, "Low energy domestic lighting", gives guidance on identifying suitable locations for fixed energy efficient lighting.*
Fixed external lighting	Where fixed external lighting is installed, provide ***light fittings*** with the following characteristics: a. Either: i. lamp capacity not greater than 100 lamp-watts per light fitting; and ii. all lamps automatically controlled so as to switch off after the area lit by the fitting becomes unoccupied; and iii. all lamps automatically controlled so as to switch off when daylight is sufficient. b. Or i. lamp efficacy greater than 45 lumens per circuit-watt; and ii. all lamps automatically controlled so as to switch off when daylight is sufficient; and iii. light fittings controllable manually by occupants.	

Table 40: Recommended minimum standards for fixed internal and external lighting *(continued)*

British Standards

BS EN 15193:2007 "Energy performance of buildings – Energy requirements for lighting".

Other related documents

CE80 "Domestic lighting innovations", Energy Efficiency Best Practice in Housing.
CE61 "Energy efficient lighting – guidance for installers and specifiers", Energy Saving Trust.
EP84 "Housing for people with sight loss", Thomas Pocklington Trust Design Guide.
IP412 "Making the most of your sight: Improve the lighting in your home", RNIB and Thomas Pocklington Trust.

Energy Saving Trust best practice standards

The Energy Saving Trust sets best practice "Energy Saving Recommended (ESR)" standards for lamps that cover not only energy efficiency, but also other aspects of quality including colour rendering, warm-up time, product life and power factor. It is advisable to install only ESR low energy lamps in dwellings.

Section 13

Micro-combined heat and power packages

13.1 Scope of guidance

This section provides guidance on the specification of micro-combined heat and power (micro-CHP) packages for dwellings to meet relevant energy efficiency requirements in building regulations.

The guidance covers micro-CHP systems with an electrical output less than 5 kWe which are:

- heat-led
- capable of exporting electricity to the grid, and
- controlled in such a way as to avoid heat dumping.

13.2 Key terms

Heating plant emission rate (HPER) is the annual CO_2 emissions from fuel and power consumed by the heating plant, offset by the emissions saved as a result of any electricity generated by the heating plant, divided by the heat output over a year. It is measured in units of kg of CO_2 per kWh. To calculate ***HPER*** it is necessary to know the ***plant size ratio***. Note: The ***HPER*** includes any auxiliary space and water heating that may be necessary, i.e. it represents the performance of all heating plant needed to provide space and water heating service to the building, assuming a standard demand pattern.

Plant size ratio (PSR) is defined as the nominal heat output of the heating plant divided by the design heat loss (the average heat loss of the building on a cold day with a temperature differential of 24.2°C). Note: For a given heat demand, the ***PSR*** determines the part-load condition for the heating plant.

13.3 Micro-CHP systems

a. For ***new systems*** and ***replacement systems,*** the HPER of the micro-CHP package (calculated as in c. below) should be no greater than the carbon emission factor for the fuel divided by the minimum efficiency for a regular boiler using that fuel, at the PSR determined as in b. below. The design heat loss of the dwelling should be calculated using the Energy Saving Trust's *Whole house boiler sizing method for houses and flats* [10].

b. The ***PSR*** for the micro-CHP system when operating in the intended dwelling should be calculated as defined in 13.2 above.

c. The ***HPER*** of the micro-CHP system should be calculated at the ***PSR*** determined in c. above, using the methodology set out in DECC's Annual Performance Method (APM)[11], and the performance data for the micro-CHP package estabilied by testing according to BSI PAS 67[12].

Supplementary information

British Standards

BS EN 15316-4-4:2007 "Heating systems in buildings – method for calculation of system energy requirements and system efficiencies – Heat generation systems, building-integrated cogeneration systems".

Other documents

Appendix N of SAP 2009 "Method to evaluate the annual energy performance of micro-cogeneration heating systems in dwellings".

BSRIA BG 2/2007 "CHP for existing buildings: Guidance on design and installation".

[10] Energy Saving Trust CE54 *Whole house boiler sizing method for houses and flats.* This is an interactive calculator available from the Energy Saving Trust at www.energysavingtrust.org.uk/housingbuildings/publications. The design heat loss in kW is the basic design heat loss in box U (from the 2010 edition).

[11] *Method to evaluate the annual energy performance of micro-cogeneration heating systems in dwellings* (APM), SAP 2009 revision, DECC. Available from www.bre.co.uk/sap2009.

[12] BSI PAS 67: 2008 *Laboratory tests to determine the heating and electrical performance of heat-led micro-cogeneration packages primarily intended for heating dwellings*.

Section 14

Heating system circulators

14.1 Scope of guidance

This section provides guidance on the specification of stand-alone, glandless heating system circulators to meet relevant energy efficiency requirements in building regulations.

The guidance does not apply to circulators supplied as integrated units within the casing of boilers.

14.2 Circulators

Heating system circulators provided as part of ***new systems*** or ***replacement systems*** in dwellings should meet the minimum standards for energy efficiency in Table 41.

Table 41: Recommended minimum standards for stand-alone, glandless heating system circulators

New and replacement systems	Supplementary information
a. Stand-alone glandless circulators should be labelled for energy efficiency in accordance with the Europump Labelling Scheme, and have a rating in the range A to G.	*Further information and guidance, including a list of approved glandless domestic circulators, is available at www.bpma.org.uk.* *The EuP Directive will introduce a requirement for all circulators placed on the market from January 2013 to have a minimum Energy Efficiency Index (EEI), initially equivalent to an A-rating under the Europump Labelling Scheme, and later equivalent to an A* rating. To meet these standards, over the next three to five years the circulator industry will have to switch from using induction motors to permanent magnet motors.*